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A

TREATISE

ON THE

MULBERRY TREE

AND

SILKWORM.

AND ON THE

PRODUCTION AND MANUFACTURE OF SILK.

EMBELLISHED WITH APPROPRIATE ENGRAVINGS.

BY JOHN CLARKE,

SUPERINTENDENT OF THE MORODENDRON SILK COMPANY OF PHILADELPHIA.

SECOND EDITION.

Look to the Silk Culture for the true Gold Mines of the United States, leading to Independence, Wealth, and Power.

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PHILADELPHIA.

PREFACE.

"Not to know what occurred before one was born, is to be," said an ancient writer, "always a child." Knowledge, indeed, is that to which, as a means, we owe our all. And whatever we shall, or shall not, be or possess hereafter, will be measured by knowledge, or the want of it; or by our diligent use or neglect of it. Knowledge, in short, should be hailed, invited, as our best friend; whilst its reverse, ignorance, our worst, if not our only enemy, should be scouted, were it possible, from the very face of an earth tenanted by man, by all that aspire to the dignity of the intellectual character. On knowledge, or on the want of it, how often has depended whether whole nations shall be civilized or uncivilized, as well as learned or unlearned; whether whole kingdoms shall slumber for centuries in comparative barbarism, as well as whether the myriads of individuals composing them shall spend their existence in prosperity and peace, or be immured in wretchedness, to bequeath it, as an entail, to their posterity after them.

A Providence, kind and paternal, however, deserts not man, unless he neglect himself. The *inventive faculty* is given to him. "Necessity," it is commonly said, "is the mother of invention;" but with all deference to her maternal powers, it may be added, that they would be unproductive, were it not for the astonishing and yet undeveloped powers of *mind*. The history of mind, could it be well composed—and of its inventions and discoveries, for five thousand years, in the arts, in science, in manufactures, in implements, in machinery, and in productions of every kind, sweeping in its universe of evolutions, the two empires of material and immaterial being—would present at once the most interesting and important detail of the great and mystic movements of what the same Providence has placed here, on this earth, to be the *sovereign of matter*. We repeat it, *Mind is the sovereign of matter!* Matter, it is true, in all forms, is created from age to age, ready to our hands, by the same Paternal energy; but it is left to the empire of instinct and reason, or of mind, through all its divisions of power, to move, change, transform, metamorphose it into other forms, substances, shapes, and modifications, so dissimilar, that the crude ore of the mountain becomes the spangling specie of the bank; the fleece of an animal, the clothing of man; the cotton of a vegetable, the calico, the muslin of the store; and the leaf of the mulberry tree, the velvet cushion of the throne, or the robes that embellish the persons of emperors and of queens.

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Such is mind! It reigns supreme: its sway "*there is none to dispute.*" On the throne of instinct, reason, it sits: it waves the hand; onward is the march, the great triumphal march of mind; and immediately a host of satellites—for such there must be in the rear of every sovereign—are in motion; writers, authors, copyists, compilers, historians, are pushing after it, *in the orbit of intellect*, with all the speed and splendour that can be given by essays, histories, digests, encyclopædias, periodicals and manuals; and such has been the rapidity of late, that even the press, with all its additional powers of type and stereotype, travels not with sufficient velocity, unless it move by steam! What is the cause of all this? Mind, the sovereign of matter, in the march of intellect: it approaches, probably, the perihelion: onward it must go, and our business is to follow; which, if we do, though it cannot, will not stop, it will look back to bless us, and will whisper peace and prosperity to us as a nation, and to each of us as individuals.

Our peace, our fortune, or our happiness is made, if we follow MIND! How is this to be done? History presents us with an eminence, on whose height we view, in a long and extended vista, a series of inventions counted by the thousand years, each of which has blessed mankind. On one side we see a nation deprived of their benefit, for ages slumbering in obscurity, in barbarism, and in wretchedness; there another that has embraced a gift, that seems to have dropped from the skies, whose history demonstrates to the world, more satisfactorily than the problem which cost the hecatomb, that "*knowledge is power;*" to which we add, that knowledge not only is power, but, *knowledge rightly used, is wealth and happiness.*

Knowledge has visited the American people. Volumes are in her hands; her finger first points to this page, then to that. Are we attentive? On this page we see, in prominent characters, the word *China!* and in *alto-relievo* the word *Silk!* and by attention we are enabled to decipher the words "China, in silk, an example to America." We pause; we reflect: in these words we see a volume; we have caught the idea! that idea is a world! And a volume we could write, and a new world, a new era, we could speak of; but these pages, these limits, refuse a safety-valve to the engine, to thought; the power we must diminish, and reserve for another time. Knowledge perceives that the subject is too great for our utterance; she waves her sceptre, changes the page, and turns to another, on the head of which we distinctly see the word COTTON.

Some time ago we visited the South, and lodged in this hotel, and then in that; but wherever we abode, no word heard we so frequently as the word "*Cotton!*" Cotton was said, and cotton was responded, and cotton was echoed; neither did we understand the mysteries of echo until we understood the sympathies of cotton. Not being gifted with a musical ear, we were perplexed to discover the melody of the word cotton, until a friend kindly hinted, it was the *music of the pocket!* The secret now was out, the enigma solved; and ever since, we distinctly perceived, that *cotton was music to the pockets of the people of the South.*

Two great staples of the United States of North America are now in our diorama—*Cotton* and *Silk;* but which is to become the greater, is the question. No less true is it, that all men are not born prophets,

than that the souls of all men are not integral quantities; and of these, the progenitors it was, that, sixty years ago, laughed at cotton becoming a staple of this country. But these fractional quantities we let alone: it is with integral characters only that we are concerned; with men capable of comprehending distinctly, not merely a part, but a whole subject. And these are they who proclaim that of the two, cotton or silk, the latter eventually is to become the greater, the more important staple of this country.

It is easy to form a cursory estimate of the immense benefit which the production and manufacture of cotton and its fabrics have been to this country. Great, however, as this is, we hesitate not to anticipate that silk will be—if the people, the government, the whole *commonwealth*, only evince enterprise and zeal commensurate to the object, as a staple—not inferior to cotton. The growth of the latter article is confined to the southern states; whereas every state of the Union is eligible for the production of silk. For silk as well as for cotton, independently of our own consumption, foreign markets are ready to afford the most ample encouragement. Of the raw material, France is under the necessity of importing more than one-third of her vast consumption in her manufactures; and England must import every ounce. These two kingdoms only offer a market to the value of $40,000,000 annually. We shall add to this the singular consideration, that for years past, this country has been in the habit of importing raw and manufactured silks, at the rate of $1·40 for every individual in its population, which evidently implies an ulterior amount of indefinite magnitude. For raw and manufactured silks upwards of $25,000,000 were sent abroad in the year 1836; equivalent to an annual drain of specie to that amount. We have then at once before us a market for silk, to the extent of $65,000,000 annually.

China, however, which may afford a valuable lesson at once in politics and political economy, surpasses this. There, every artisan is capacitated and encouraged to be a *consumer* as well as a *producer*. Thus her home trade is supported; and it is thus she becomes independent. Were only all the white females above the age of fifteen, of the United States, to encourage our *home trade* to the extent of one silk dress annually, it would produce an additional market of the annual amount of $66,150,000. By this means, or by others, at least, added to the preceding quotation of $65,000,000 annually, we see no limits *necessarily* restraining the extent of the silk market short of $100,000,000 per annum. And with all our exertions, it will be years before this demand is satisfied, and the check given to the serious drain of specie out of the country, to purchase of foreigners what we can produce at home.

On the subject of *specie, banks, hard coin, cash payments, mines*, and *Mexico*, we have read essays, lectures, pamphlets, and volumes, without number. But how much more simple is the course we prescribe! Only set the silk worm to work; stop the enormous drain of specie abroad, by producing all at home; and we effect at once more than all the mines, more than all the ponderous tomes, whether extended by sheet or counted by volume, though they should reach from pole to pole, could accomplish in a century. The next lecture we intend to hear on the mystery of banking, mines, specie, and hard cash, shall be given by the silk worm.

Only produce, and hard cash will come as surely as the sun will cross the equinoctial twice in each year.

Individual and national benefit are evidently here combined. But in recommending the culture of silk, there is another feature which we scarcely can omit; it is that of *benevolence*. It promises *good-will* to our fellow-men, from one end of the nation to the other. To the benefit of a *leaf-market* to towns and densely populated cities, we have in the ensuing work briefly adverted. But whether silk is cultivated in the country or town, the same beneficial consequences will attend it. The process, in an otherwise unemployed season of the year, may be conducted by females, children, and old or invalid men, unable to perform hard labour; and therefore to them, and to others, especially if we include the more extended business of reeling, it will be a *new* means of employment, industry, and gain, without interference with other sources of income. This feature alone, were there no other, is sufficient to warrant our warm advocacy of the culture. In short, on this as well as on every other point in which it presents itself to our notice, we could expatiate by the volume, whilst our limits restrict us to the line. Through several years of close attention to this subject, we have long perceived its individual, its political, its national importance; to which the numberless volumes, guides, and manuals, already existing on this topic, we have at the same time been deeply sensible, were not singly at least, commensurate, nor in every respect suited to the wants and exigencies of the young and comparatively inexperienced culturist. This desideratum we have endeavoured to supply, not only from our own experience, but from a larger collection of European and American works on the culture than is perhaps possessed by any other individual in the United States. Our work is now before the tribunal of the public. Of its comparative merits they may judge; but a conviction of our motives, and endeavours to serve all, is unalterably fixed in our own conscience; and its accomplishment of the purpose, in any degree, for which it was originally intended, is all the praise, if any, that we shall ever desire. To extend the work to comprise not only the production, but the whole of the *manufacturing* processes of silk, was our intention; but the numerous volumes we have since received, especially from Europe, and the large amount of plates relative to machinery, an explanation, at least to do justice to this important branch of national industry, would require, convinced us of the impracticability of fulfilling our original design short of the limits of a *second volume*, now in the course of preparation; and for its completion we, very respectfully, at present, beg leave to retire.

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A TREATISE

ON THE MULBERRY TREE, &c.

PART I.

HISTORY OF THE CULTURE AND MANUFACTURE OF SILK.

CHAPTER I.

PRELIMINARY REMARKS ON THE ORIGIN OF SILK CULTURE IN CHINA.

How frequently do we find that the highest elevation in character, in the wealth and independence of individuals or nations, arises from some small and apparently insignificant origin. The silk worm, the cocoon, the raw material that gives lucrative employment to myriads, mills, looms, machinery, filatures, factories, the busy merchant, the crowded warehouse, the loaded ship, transporting the rich damask, the thick velvet, the stiff brocade, the thin gauze and delicate blonde, fabrics valuable as silver, or more valuable than mines of precious metals to nations, proceed from, or are set in motion, by what? By the eggs of an insect; eggs so small that threescore scarcely weigh one grain!!

It is no less singular than true, that light, knowledge, the arts and sciences, literature, and even the gospel itself, pursue, in their respective movements, a course similar to that of the sun. They rise in the

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east, and move towards the west. Thus onward may they go till they encompass the earth, not only with a zone, but with zones of light more numerous than the belts of Jupiter or the rings of Saturn, dispelling all the proceeds of darkness, misunderstanding, and animosity, and binding man to man, nation to nation, and hemisphere to hemisphere, in one grand circle of reciprocity and fellow interest, and in all the amenities of fraternal benevolence.

In our search for the distant origin of any art or science, or in looking through the long vista of ages remote even to nations extinct before our own, we are favoured with satisfactory evidence so long as we are accompanied with authentic records: beyond, all is dark, obscure, tradition, fable. On such ground it would be credulous or rash in the extreme to repeat, as our own, an affirmation, when that rests on the single testimony of one party or interest, especially when that is of a very questionable character.

It is even more safe, when history or well authenticated records fail us, to appeal to philosophy, or to the well known laws of mind, from which all arts and science spring. The former favours us with the commanding evidence of certainty and decision; and though the latter may only afford the testimony of analogy, yet is its probability more safe, at least, than what rests on misguided calculations or on the legendary tales of artifice and fiction.

Whilst the natural sun that shines on this earth diffuses his rays equally, and illuminates a whole hemisphere at once, how different is it in reference to the intellectual sun. Here we see the latter steadily maintaining his immovable meridian over some favoured portion, some central region of the earth, even for ages, until the derivative, not the primitive rays, are transmitted to every cardinal point of the civilized nations. And after first communicating, by the latter, the *inventive* power to man, like a pillar of light gradually wending its way from east to west; or, forming a zone, of which

whilst one extremity has not yet left the east, now bending over the Atlantic, the other is already illuminating the shores of the western world.

After this view of the subject, there will be the less difficulty in arranging all the families of the earth into two divisions, strongly distinguished from each other. The one, that which has signalized itself by the possession and exercise of the *inventive talent;* a faculty in common with every other of excellence, originally proceeding from Him who is the only giver of mind and its every attribute.* In striking contrast to this is that division which comprises those nations that, instead of the *inventive*, have, from time immemorial, only evinced the *imitative* faculty. The derivative, not the primitive, rays have reached them. They may be in possession of many of the arts, and some of the sciences, but together with these they give full proof that they originated not with them. They know precisely what their fathers knew. In present emergencies, they refer to the precedent of their ancestors, rather than to the varying circumstances of the case. Their dress, their manners, their habits, their customs, their festivals, their gods, their temples, their superstition, their pagodas, in routine and fashion, are the same they were centuries ago. Improvements in the arts, or new discoveries in science they know not. And all these are so many collateral proofs, and afford strong presumptive testimony, that whatever arts, or whatever of science they inherit, they are the bequest of antecedent proprietors.†

* As a proof that the inventive faculty, as to every thing truly useful to man, originally proceeded from *the only* "*Giver of every good and perfect gift*," consult Isa. xxviii. 24 to 29: and also a beautiful comment by Dr. A. Clarke on, "And thou shalt speak unto all that are wise hearted, *whom I have filled* with the spirit of wisdom." Exod. xxviii. 3: and also on, "I have filled him with the spirit of God in wisdom, and in understanding, and in knowledge, and in all manner of workmanship; to devise cunning works, to work in gold, and in silver, and in brass; and in cutting of stones, to set them, and in carving of timber, to work in all manner of curious workmanship." Exod. xxxi. 3, 4, and 5.

† "The stationary condition of the arts and sciences in China," says a late writer, "proves that they have not originated with that people:

Frequent examples are found where the polity of a whole nation, of a whole empire, or even of a whole church, is to chain down the mind not merely of an individual, but of whole communities in all thinking, saying, doing, to the formularies of antiquated precedent. Wherever this is the case, the mind becomes habitually inert; it is circumscribed on every side by the moss-grown barriers of patriarchal times, beyond which it never dares to pass, and never knows either the joy or the fame of an Archimedes when he exclaimed Ευρηκα, ευρηκα, *I have found it! I have found it!*

No facts are of greater notoriety than those that give new and varied proofs every day, that ambition is a vice too generally prevalent in nations much more civilized than the Chinese. But that furtive species of it that induces an individual or a nation to claim this discovery or that invention, whilst it is the property of another, is, however dishonourable, too frequently practised. If a single discovery, invention, or art, is sufficient to produce this temptation, how

and many peculiarities of the manners, institutions, and popular religion of the Chinese, have a near affinity to those of the Hindoos. We have remarked the ignorance of the Chinese in mathematics and astronomy. Of physics they have no acquaintance beyond the knowledge of apparent facts. They never ascend to principles, nor form theories. Their knowledge of medicine is extremely limited, and blended with the most contemptible superstition. Of anatomy they know next to nothing; and in surgery, they have never ventured to amputate a limb, nor to reduce a fracture. The Chinese are said to have manufactured glass 2000 years ago, yet at this day it is inferior in transparency to the European, and is not used in their windows. They are reported to have known gunpowder from time immemorial, but they never employed it in artillery or fire arms, till they were taught by the Europeans. When first shown the use of the compass in sailing, they affirmed that they were well acquainted with it, *but found no occasion to employ it!*" If they are indeed conversant with navigation, let them prove it, by sending a vessel, navigated by a Chinese captain, here. "The art of painting in China is mere mechanical *imitation*, without grace, expression, or even accuracy of proportions: of the rules of perspective they have not the smallest idea. In sculpture, as in the figure of their idols, the Chinese seem to delight in distortion. The knowledge they have seems to have been imported, and not of original growth, for it has never been progressive." See also M. Bailly's Theory of the Origin of the Sciences among the Nations of India.

much stronger must this be, when it refers to a whole circle of such discoveries or arts, on which the aggrandizement and independence of an empire is supposed to depend? What a necessary part of the policy of such a commonwealth must it be, to adopt every manœuvre to preserve concealment, or to shroud the whole in the distant mists of extreme and visionary antiquity. What motives have the Chinese had, in which they have had no parallel amongst any other people, to isolate themselves, from the earliest times, from the scrutiny of other nations; to burn, in the reign of Tchehoam-ti, all their historical writings, to bury alive their learned men, to destroy effectually the dates and records of past events, and to sanction the Jesuits in the calculation of eclipses, to the knowledge of which the Chinese pretend, but could never use or exemplify, except when surreptitiously obtained, for the purposes of subtlety and deception.

The advocates for the extreme antiquity of the Chinese, assert that their empire has subsisted above 4000 years, and appeal, as a proof, to a series of eclipses marking contemporary events, calculated for 2155 years before the Christian era. The present Chinese have no such knowledge of the motions of the celestial bodies as to enable them to calculate eclipses. They can no more calculate one eclipse, past or future, much less a series, than they can navigate a ship from Canton to Acapulco. But the Jesuits who presided there in the tribunal of mathematics, for more than 200 years, calculated for them, these eclipses, in order to ingratiate themselves with the emperors, and to flatter Chinese vanity. And if they could have done this, still it proves nothing. It is easy to calculate eclipses backwards from the present to any period, and thus to give to any *fictitious* portion of history its chronology of *real* eclipses. But no valid conclusion can result from this, unless it were likewise proved that all those eclipses were not only actually recorded at the time when they happened, but also in reference to some historic

event. But this neither has nor can be done; for it is an allowed fact, that there are no authentic Chinese records beyond the third century prior to the Christian era. Hence, there is no argument; and the futility of such an artifice is too self-evident to have demanded the able pen of so eminent an astronomer as La Place* to expose the chicanery of such a subterfuge.†

We have, however, authentic testimony that the *inventive* faculty existed at a very early period. The peculiar condition of man at that time must have afforded many imperative occasions for its exertion. Hence we read that "Jabal‡ was the father of such as dwell in tents," (*inventor* of tent-making;) that "Jubal, his brother, was the father," (*inventor*)

* See La Place on the subject.

† Neither is it always considered, in referring to any distant period, especially as to remote nations, or prior to the time of Sosigenes, what we are to understand by the word *year*. The solar year is 365 days, 5 hours, 48 minutes, 51·6 seconds precisely, and no other computation, whether what is called the Julian year of 365 days 6 hours, or what is commonly, but erroneously quoted as a tropical revolution, 365 days 5 hours 48 minutes and 45 seconds, will correspond to solar time, without periodic corrections, such as the intercalation of a day every leap year, and the omission of three days every 400 years, according to the edict of Gregory XIII: and even then there will be an error of 5 hours and 40 minutes every 1000 years. If then, we, the moderns, find such difficulty in keeping pace with the sun, what did the ancients do? The very circumstance of our present years commencing on the 1st of January, instead of at the winter solstice, is a proof of their predilection for lunar instead of solar time. For the new moon happening 8 days after the solstice, when Cæsar first adopted the Julian computation, the year was made to commence on that day instead of when the sun entered Capricorn. Before this the year amongst all nations was lunar, containing precisely so many *moons*, *moonths*, or *months*, each beginning on the day of the new moon, though they consisted of a different number of days. The Hebrew and Greek year contained 354 days; that of Numa Pompilius, 355, and the year of Romulus comprised only 304 days. The very terms expressive of time, as *calendar* from καλεω to call, or from the calling together of the people on the first day of the new *moon;* or *annus*, κυκλος, &c. from which we have *annual*, cycle, &c. being ambiguous, and signifying a *circle* as well as *time*, have occasioned some to suspect that anciently, especially amongst remote nations, these circles were the less and not the greater, and therefore lunar, and absolutely moonths, not years.

‡ Gen. iv. 20.

of musical instruments: such as the *kinnor*, harp, or stringed instruments, and the *ugab*, organ, or wind instruments; that "Tubal-cain was the instructor of every artificer in brass and iron," the first smith on record, or one to teach how to make instruments and utensils out of brass and iron; and that the sister of Tubal-cain* was Naamah, whom the Targum of Jonathan ben Uzziel affirms to have been the *inventrix* of plaintive or elegiac poetry. Here is then an account of the *inventive* faculty being in exercise 3504 years before the Christian era; or 1156 years prior to the deluge; or 804 years before the earliest period assigned to the Chinese for the discovery of silk. And of whatever arts or sciences existing amongst men prior to the deluge, there is no difficulty in conceiving the possibility of the transmission of the leading and most essential parts, at least, to the post-diluvians, by the family of Noah.

But instead of giving our unqualified assent to what has been servilely copied from book to book from the most accessible account, we shall advert to the great discrepancy relative to Chinese chronology, amongst those who have had equal access to their records. Thus the time of Fohi, the first emperor, has been said to be 2951 B. C. by some 2198 B. C., and by others 2057, or about 300 years after the deluge: of Hoang-ti, 2700 B. C., by Mailla it is quoted at 2602 B. C., by Le Sage at 2597 B. C., and by Robinson and others at 1703 B. C. Similar disagreements might, would our limits allow, be observed concerning

* It is worthy of remark that M. de Lavaur in his *Conference de la Fable avec l'Histoire Sainte* supposes that the Greeks and Romans took their smith-god *Vulcan* from Tubal-cain. *Tubal-cain* is, indeed, easily convertible into *Vul-can*, who was also an artificer, a master smith in brass and iron. Now if the Greeks and Romans, through that change of letters, syllables, or sounds, which one language is liable to suffer in its transit to another, and through the obscurity of tradition, could so easily mistake one sound or name for another, or substitute a fictitious for a real character; it becomes a matter of still greater probability that similar substitutions may be found, especially in that part of Chinese history which is extremely remote and fabulous.

the rest, and particularly of the emperors, Hiao-wen-ti, Chim-ti, Ming-ti, Youen-ti, Wen-ti, Wou-ti, and Hiao-wou-ti. Even in more modern times, and relative to a character so notorious as Confucius, no less than three dates are equally affirmed to be true. As to Hoang-ti, who is said to have begun *the culture of silk*, we are inclined to prefer the latter account, 1703 B. C., which makes him contemporary with Joseph, when prime minister over the land of Egypt.

As a confirmation of this, it may be stated, that by referring to the account given of nine* of the patriarchs at this period, we shall find that the average age of man was then 186 years; and that the duration of human life, *before much greater*, soon after rapidly declined. Now the average duration of the reigns of the first three† Chinese emperors, including Hoang-ti was 118 years; of the five that immediately succeeded, only 68 years. After this, until the Christian era, the average duration of a single reign of the Chinese emperors did not exceed 23 years, and thence until the present time not 13 years. Since, therefore, the average duration of the reign of the first three emperors bears an evident and fit proportion to that of the age of man at the period specified, though not at any other before or after, being in the former case as much too small as it would in the latter be too great, the opinion we have offered is the only one that can be consistent with these striking facts; and, if duly considered, presents an argument strongly corroborating the view we have taken of the subject.

The attempt to establish any greater certainty, in a case of this nature, the Chinese during the dynasty of Tschin, having, to conceal the truth, destroyed every thing authentic, would be in vain. It would be even more rational to have recourse to the Vedas, or sacred books of the Brahmins, or to records in the

* Peleg, Reu, Serug, Nahor, Terah, Abraham, Isaac, Jacob, and Joseph: Gen. xi. 16 to 26; xlvii. 28; and l. 26.

† Fohi, Eohi Xinum, and Hoang-ti.

ancient Sanscrit, were it not a well known fact, that nearly all ancient nations, except the Jews, actuated by the same ambition, have betrayed a wish to have their origin traced as far back as the creation. And in the gratification of this passion none are so notoriously pre-eminent as the Egyptians, Hindoos, and Chinese. For them the limits of the creation itself have been too narrow, and days, weeks, and even months too short, unless multiplied into years.*

Whenever authentic records fail, fable or hypothesis alone can supply the place. The former can only amuse us with a whole host of gods, demi-gods, satyrs, nymphs, and heroes. As to the latter, our only alternative is to select the one that has the strongest presumptive testimony in its favour.

The strong resemblance, in several respects, between the Chinese and the ancient Egyptians, has almost irresistibly given rise to the conjecture that originally they were the same people. M. de Mairan informs us, that the Egyptians and Chinese were strikingly similar in the following points: the same permanency of manners, abhorrence of innovation, aversion to war, a superficial knowledge of the arts and sciences without the ability to make improvements or discoveries; and, in more remote times, the use of hieroglyphics. A festival of the Egyptians called *the feast of the lights*, corresponds to that of the Chinese, *the feast of the lanterns:* the features of the Chinese resemble the ancient Egyptian statues; and certain characters engraven on an Egyptian bust of Isis were found to belong to the Chinese language.

"If we find," says M. Bailly, "in the scattered huts of peasants, fragments interspersed of sculptured columns, we conclude with certainty that they are not the work of the rude peasants who reared those huts, but that they are the remains of a magnificent building, the work of able architects, though we dis-

* See Dr. A. Clarke's remarks: end of Gen.

cover no other traces of the existence of that building, and cannot ascertain where was its precise situation." From this argument, and a comparison of the manners, customs, opinions, and attainments of the *Indians*, *Persians*, *Chinese*, *Chaldeans*, and *Egyptians*, and a discovery of many circumstances of similarity between all those nations, M. Bailly comes to the singular conclusion, that the knowledge common to all has been derived from the same original source, a most ancient and highly cultivated people of Asia, of which every trace is now extinct.*

* "The sciences and arts of the Chinese have been stationary for 2000 years. The Chaldeans were a comparatively enlightened people at the commencement of the Babylonish empire, or so early as 1900 A. M. We find, soon afterwards, that they were astronomers, and understood the revolutions of the celestial bodies. The Chaldeans probably proceeded from this ancient people. In the leading and more essential points of theology, the belief of the Brahmins is the same as was that of the Chaldeans, though subsequently intermingled with many absurdities, the result of their superstition and ignorance. The elegant and copious language, the Sanscrit, the source of all Indian knowledge, has been now a dead language for more than 2000 years, and is intelligible only to a few of the Brahmins. It was probably the language of that great and ancient people.

"The custom of libations and religious ablutions was common to the Tartars, Chinese, and Hindoos, as well as to the Greeks and Romans. All the Asiatic nations had festivals of the nature of the Roman saturnalia. The tradition of the deluge is diffused among all those nations; and that of the giants attacking heaven, (tower of Babel) is equally general. The doctrine of the metempsychosis was common to the *Egyptians*, *Greeks*, *Indians*, *Persians*, *Tartarians*, and *Chinese*. *A conformity in a true doctrine is no proof of mutual communication or concert; but it is ingeniously remarked, that a conformity in a false doctrine comes very near to such a proof.*"

"The Egyptians, Chaldeans, Indians, Persians, and Chinese, all placed their temples fronting the east. All these nations had a cycle or period of 60 years for regulating their chronology. They all divided the circle into 360 degrees; the zodiac into 12 signs, and the week into 7 days. The Chinese, Indians, and Egyptians distinguished the seven days of the week by the names of the seven planets ranged in the same order. The long measures of the ancient nations had all one common origin."

"These singular coincidences," says M. Bailly, "can be explained only upon one or the other of the following three suppositions: 1st, that there was a free communication between all those ancient nations; 2ndly, that those circumstances of coincidence are so founded in human

From the Egyptians, it is well known, that the Greeks, those venerable models of fine taste, of the arts and sciences, received the first rudiments of their knowledge. And M. de Guignes of the Academy of Sciences and Belles Lettres in France, has presented strong presumptive testimony that the Chinese, (he might probably have added the Hindoos,) were originally an Egyptian colony. He has discovered the very remarkable fact, that *the first Chinese sovereigns were precisely the same, as those of Thebes in Upper Egypt.* He concludes from thence, with sufficient reason, that an Egyptian emigration, of which we find some traces in their history, settled themselves upon the borders of the eastern ocean, and grafted the history of their native place, upon that of the soil of their adopted country. He moreover points out an evident affinity between the Chinese alphabet and the Egyptian hieroglyphics. Whether M. de Guignes is correct in his conjectures or not, it is certain, that there is an extraordinary similitude in the manners, genius, morals, and character of these two distant nations; and it must be confessed that the collective testimonies adduced by him approximate to that evidence which demands conviction.

Admitting, as is equally, if not still more probably a fact, that the Chinese emigrated from the Hindoos, and the latter from the Egyptians, Sir William Jones, consistently with the above hypothesis, and with evidence deduced from the high authority of the Sanscrit, traces the origin of the Chinese from the Hindoos. He appeals to passages of the ancient Sanscrit records, which mention a migration of certain of the military class termed *Chinas* from India to the countries east from Bengal. If to a declaration from

nature, that the most unconnected nations could not fail to hit upon them; or, 3dly, that they have been all derived from a common source. He rejects the two former suppositions as contrary, in his opinion, to the ordinary course of things, as well as to matter of fact; and adopts the last."

the Sanscrit, by so competent an authority as Sir William Jones, be added the allowed affinity existing between the manners, institutions, religion, and peculiarities of the Hindoos and those of the Chinese, we have an evidence relative to the origin of the latter, which, if it obtain not our entire credence, is, at least, entitled to our respect.

But our belief of this is further strengthened from the consideration, that in the days of Ninus, A. M., 1995, the Assyrian empire extended from Egypt to Bactria,* now a part of Bukharia; and in the time of Semiramis, the conquests were pursued to the south and east, as far as the river Indus. The transit, therefore, of Egyptian colonists to India or Hindoostan, at this time, was easy; since one interest, or one government prevailed from Egypt on the southwest to Bactria on the north, and to the Indus on the southeast. Nineveh† founded by Asshur,‡ the second son of Shem, who gave his name to *Assyria*, was in the early part of the reign of Semiramis the metropolis of the Assyrian government, but in the latter part, the capital was established at Babylon: the Chaldeans, at that time, being a part of the same empire. Both the Egyptians and Chaldeans were renowned for their early acquaintance with the arts and sciences. We perceive, therefore, the united lore of both already on the march to India. And if the rest of that march we give up to the high authorities of Sir William Jones and the Sanscrit, that announce to us an "early migration of the military class, the *Chinas* from India to countries east of Bengal," we are, together with our Egyptian and Chaldean§ colonists, in *China* at once.

* Bactra, the capital, was about 60 miles to the north of the present Samarcand, the metropolis of the great conqueror Tamerlane.

† Now called Mossul, on the banks of the Tigris.

‡ Gen. x. 11 and 22.

§ "In confirmation that all men have been derived from one family, let it be observed, that there are many customs and usages, both sacred and civil, which have prevailed in all parts of the world, which could owe their origin to nothing but a general institution, that could never

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But who was Fohi, or the supposed first Chinese emperor? And who were the Seres, the reputed first cultivators of silk, and where did they dwell? We shall begin with the latter inquiry first.

Dr. Lardner informs us that "*Se* is the name for silk in the Chinese language; this, by a faulty pronunciation in the frontier provinces, acquired the final *r*, thus changing the word into Sēr, the very name adopted by the Greeks." And under the word Σηρ, in the Lexicon of Hesychius we read σκωλυξ γενων το σηρικον, the worm which produces the silk thread. Its plural is found in the same sense in the letter of the emperor Julian, οἱ Περσικοὶ σῆρες, the Persian silk worms. *Seres* also in the plural, was employed by the Greeks and Romans to signify the people who attended to silk worms. Hence Serica, the country of the *Seres;* which was sometimes written *Sereinda*, a term applicable indefinitely to any country inhabited by the *Seres** or silk growers, beyond the Indus.†

By the ancients, and in maps of ancient geography, Serica is differently placed, sometimes more to the

have existed, had not mankind been of the same blood originally, and instructed in the same common notions before they were dispersed. Among these usages may be reckoned, 1. The numbering by *tens*. 2. Their computing time by a cycle of *seven* days. 3. Their setting apart the *seventh* day for religious purposes. 4. Their use of *sacrifices*, *propitiatory*, and *eucharistical*. 5. The consecration of *temples* and *altars*. 6. The institution of *sanctuaries* or places of refuge, and their privileges. 7. Their giving a *tenth* part (tythe) of the produce of their fields, &c. for the use of the altar. 8. The custom of worshipping the Deity *bare-footed*. 9. Abstinence from sensual gratification previous to offering sacrifice. 10. The order of *priesthood* and its support. 11. The notion of legal pollutions, defilements, &c. 12. The universal tradition of a general deluge. 13. The universal opinion that the *rainbow* was a divine *sign* or portent, &c. See Dodd." Dr. A. Clarke on Gen. x. 26.

The Chinese use certain purifications even before they enter their cocooneries. See a summary of the principal Chinese Treatises on the Culture of Silk, &c., published in 1838, by P. Force, Washington.

* Hence the Greek term for silk, σηρικον, the Latin *sericum*, the Italian *seta*, the French *soie*, and the English *silk*. In more modern times, from βομβυξ, or Bombyx mori, the caterpillar of the mulberry, we find the terms Bombycina, and Bombykia employed to signify silk.

† Not beyond the Ganges as has been inconsiderately affirmed.

east, at others to the west, but never beyond the 48th degree of north latitude. This is indefinite, but easily accounted for from the consideration that the ancients had only a confused idea of central Asia. They gave it the vague denomination of Scythia beyond Immaus, though that included that vast region, now known as Chinese Tartary, ranging from the Belur-tag mountains on the west to the Pacific on the east. They, therefore, wrote so imperfectly of the exact position of *Seres*, *Serica*, or *Sericane*, as to occasion considerable dispute amongst European writers on the subject, whilst some, for no better reason than that deduced from the *more modern* site of the silk trade, have placed it in northern China. But we are informed by Madame Coindé, that an enlightened critic, without stating his name, has assigned satisfactory reasons for placing aboriginal Serica in little Bucharia, a country crossing the 40th parallel of north latitude near the eastern fronts of the Belur-tag mountains; whence migration subsequently may have taken place to China proper.

We have seen that the most probable account relative to the time of Fohi, said to have been the first Chinese emperor, is, that he reigned 2057 years before the Christian era, or in the year of the world 1947. "According to the most current opinion," says M. Lavoisne, "China was founded by one of the colonies formed at the dispersion of Noah's posterity, under the conduct of Yao, who took for his colleague Chun, afterwards his successor. But most writers consider Fohi to have been Noah himself."

Now the deluge terminated A. M. 1657, and Noah lived after the deluge 350 years,* and therefore died A. M. 2007; and as Fohi is said to have reigned 114 years, before Eohi Chun or Chinun succeeded him, he was cotemporary, at least, with Noah. The ark rested on Mount Ararat, which is generally allowed to be one of the mountains of Armenia, to the east of

* Gen. ix. 28.

the head of the Tigris. And here the same author remarks, that "in rather less than a century and a half, after the birth of Peleg, it is supposed that Noah, being then about his 840th year, wearied with the growing depravity of his descendants, retired with a select company to a remote corner of Asia, and there began what in after ages has been termed the Chinese monarchy." Little Bukharia assigned by Madame Coindé as the first settlement of the *Seres*, frequently translated Chinese, is certainly not far from the head of the Tigris. But here we take our leave of hypothesis, being not partial to any beyond what truth and future investigation will warrant, contenting ourselves with having shown that the most respectable testimonies relative to China are compatible with the most authentic records, now extant, in the world.

Having offered these preliminary remarks, and given the most credible hypotheses to supply the place of absolute fiction; finding also that the theories and even reputable testimonies presented by Messieurs Mairan, Bailly, Guignes, and Sir William Jones, are perfectly compatible with each other, and allow us to demonstrate that the transit of more central aborigines, since the deluge, to the extremes of China, was perfectly feasible, and a matter of even high probability, we have sufficient warrant to decline repeating whatever any one else has said relative to the extreme antiquity of the first discovery of silk. With a considerable portion of mankind, the passion for the marvellous is excessive. China and other distant regions have been a convenient fund to draw upon. Had it not been for this source, the legends of Greek and Roman mythology having been long since given up as the mere bagatelle for the school-boy, there would have been a dearth. Fortunately for this purpose China is remote, access to her is denied, her ancient records are burnt; yet what has been written since, we are told, is more ancient than Egyptian pyramids. Thus the fund is renewed; and in our search for the new and strange, we are, conveniently

enough, sent to China, to the Pelew Islands, to the depths of Nubia, to Gondar, or to Tombuctoo, where, of course, no one else can go. Of emperors the Chinese boast of 244, from Fohi the first, to Kia-Kim the present sovereign; and of gods, goddesses, demi-gods, and semi-goddesses, heroes, heroines, satyrs, fauns, the Pelopidæ, Heraclidæ, Labdacides, and Tyndaridæ, river, wood, and mountain nymphs of Greek and Roman mythology, without the name of emperor, king, or consul of authentic history, we ourselves can furnish, by genealogy and pedigree, a catalogue of more than 666, and calculate, as well as the Jesuits, eclipses for them too, if required; and how many more they had, to whom as yet we have not had the honour of an introduction, we know not.

ADDITIONAL NOTES.

In Russel's View of Ancient and Modern Egypt we find, relative to the subject of the preceding chapter, so many valuable remarks, and that evidence, which it has cost the world ages to collect, that we cannot persuade ourselves to withhold such as our limits will allow from our readers; and therefore add the following notes.

1. "It has long been an object of inquiry among scholars to discover the channel through which civilization, science, and an acquaintance with the liberal arts first reached the valley which is watered by the Nile. Without analyzing the numerous hypotheses which have been successively formed and abandoned, we shall state at once as the most probable of the opinions that have been entertained on this subject, that the stream of knowledge, from the first family, accompanied the progress of commerce along the banks of those great rivers, which fall into the Persian Gulf, and thence along the coast of Arabia to the shores of the Red Sea. There is the best reason to believe that those passes or lateral defiles which connect the sea just named with the river of Egypt, witnessed the earliest migration of colonists from Asia; who, in the pursuits of commerce, or in search of more fertile lands, or of mountains enriched with gold, found their way into Nubia and Abyssinia. Meantime it is possible, a similar current set eastward across the mouths of the Indus, carrying arts and institutions of a corresponding character into the countries which stretch from that river to the great peninsula of Hindoostan.

2. "The most obvious confirmation of the opinion now stated may be drawn from the striking resemblance which is known to subsist be-

tween the usages, the superstitions, the arts, and the mythology of the ancient inhabitants of western India, and those of the first settlers on the Upper Nile. The temples of Nubia, for example, exhibit the same features, whether as to the style of architecture, or the form of worship which must have been practised in them, with the similar buildings which have been recently examined in the neighbourhood of Bombay. In both cases they consist of vast excavations hewn out of the solid body of a hill or mountain, and are decorated with huge figures which indicate the same powers of nature, or serve as emblems to denote the same qualities in the ruling spirits of the universe.

3. "As a further proof of this hypothesis, we are informed that the Sepoys who joined the British army in Egypt under Lord Hutchinson, imagined that they found their own temples in the ruins of Dendera, and were greatly exasperated at the natives for their neglect of the ancient deities, whose images are still preserved. So strongly indeed were they themselves impressed with this identity, that they proceeded to perform their devotions with all the ceremonies practised in their own land. There is a resemblance too, in the minor instruments of their superstition—the lotus, the lingam, and the serpent,—which can hardly be regarded as accidental; but it is no doubt in the immense extent, the gigantic plan, the vast conception which appear in all their sacred buildings, that we most readily discover the influence of the same lofty genius, and the endeavour to accomplish the same mighty object. The excavated temple of Guerfeh Hassan, for instance, reminds every traveller of the cave of Elephanta. The resemblance, indeed, is singularly striking; as are all the leading principles of Egyptian architecture to those of the Hindoos. Many even of the rites and emblems are precisely the same, especially those of the temples dedicated to Iswara, the Indian Bacchus. In truth they are so much alike that the same workman might almost be supposed to have superintended the execution of them in both countries. In India and in Egypt the hardest granite mountains have been cut down into the most striking, if not the most beautiful fronts of temples adorned with sculpture. In both countries large masses of rocks have been excavated into hollow chambers, whose sides are embellished with columns and statues of men and animals carved out of the same stone; and in each are found solid blocks of many hundred tons weight, separated from the adjoining mountain, and lifted up into the air. By whom and by what means these wonderful efforts have been accomplished is a mystery sunk too deep into the abyss of time ever to be revealed. We need only compare the monolithic temples of Nubia with those of Mahabulipoor, the excavations of Guerfeh Hassan with those of Elephanta, and the grottoes of Hadjur Silsili with the caverns of Ellora, to be convinced that these sacred monuments of ancient days derived their origin from the same source."

4. "A resemblance of a corresponding nature has been discovered in the religious usages of the *Chinese* compared with those of the Egyptians, particularly in what is called the feast of lamps, a festival annually observed by the latter people, and graphically described by Herodotus This coincidence led M. de Guign s to conclude that the first inhabitants of China must have been a colony from Egypt. But it is easy to account for all such facts on a much more rational hypothesis. No one

can have failed to remark, that among the more ancient nations, there is a great similarity in point of tradition, habits, opinions, knowledge, and history. The *Babylonians*, the *Egyptians*, the *Assyrians*, the *Hindoos*, and the *descendants of Abraham*, held many things in common respecting the creation of the world, the great deluge, the dispersion of the human race, and the first institution of laws and religious worship. Hence we may conclude that the general agreement in these particulars, which we contemplate among the more primitive tribes of mankind, ought to be ascribed to the instruction which they had received while as yet they were but one family, or to the traditionary tenets which had spread, with here and there a little variation, with the diverging lines of their successive tribes, though derived originally from the same source.

5. "But by far the most striking point of resemblance between the ancient inhabitants of Egypt and of India is the institution of castes; that singular arrangement which places an insuperable barrier between different orders of men in the same country, and renders their respective honours, toils, and degradations, strictly hereditary and permanent. Before the invention of letters, indeed, mankind may be said to have been perpetually in their infancy; whence arose the expedient, founded in a view for the public good, of compelling sons to cultivate the arts which had originated in their families, and to follow the professions whereby their fathers had acquired distinction. The narrative of Herodotus bears evidence to the same institution at an early period among the Egyptians. And his statement when compared with that of Diodorus Siculus at a later epoch, removes every shadow of doubt in regard to the identity of the principle from which this political arrangement must have originally proceeded."

The reader will not be disappointed in perusing the whole of the highly interesting volume from which these notes are extracted.

CHAPTER II.

HISTORY OF SILK TO THE PERIOD WHEN SILK WORMS WERE FIRST INTRODUCED INTO EUROPE.

THOUGH we are called upon in this chapter to give the chronology relative to the early culture of silk, as found in Chinese documents, yet we are by no means pledged to affirm that either in the authenticity of the books, or in the correctness of the dates have we any faith. The whole of this, for the several irrefragable objections already assigned, is exceedingly questionable. M. Lavoisnè dates the commencement of the Chinese dynasties at A. M.* 1816, or 159 years after the deluge. The Rev. J. Robinson of Christ Col., Cam., at A. M. 1947. We have already given as strong reasons, as under the extreme incertitude of the case, can, perhaps, be offered, for preferring the latter: the important points may be briefly stated, thus:

End of the deluge.....†1657 A. M.
Fohi, first emperor, began to reign.....1947 A. M.
Noah died.....2007 A. M.
Eohi Chinun, second emperor, began to reign.....2061 A. M.
Hoang-ti, the third emperor, began to reign.....2201 A. M.
Hoang-ti, after establishing the silk culture, died.....2301 A. M.
And was therefore contemporary with Joseph when administering the affairs of Egypt.

We have already seen that *Seres* is the term originally employed for the *silk growers*, and since iden-

* We prefer this mode (A. M. anno mundi, in the year of the world) of marking the time of events prior to the birth of Christ, which according to the commonly received chronology was A. M. 4004.

† It will here not be improper to observe that the Samaritan text and Septuagint version of the Hebrew, carry the deluge as far back as to the year 3716 before Christ; or 1000 years before the Chinese account of Hoang-ti. On this subject see the New Analysis of Chronology, by the Rev. W. Hales, D.D., 4to. 3 vol.

tified with the Chinese: *Serica*, the *silk growing country*, was therefore that of the Seres. Serica, in the most indefinite sense, was thought to be some region within what we call Chinese Tartary: by others, perhaps, inconsiderately placed in China proper; but by an ingenious author, quoted, but not named, by Madame Coindé, in Little Bukharia, near the Belur-tag mountains. We are not disposed to contemplate *Sereinda*, or the silk country beyond the Indus, as a distinct section of *Serica*. The course of the Indus, from which Sereinda is designated, is on the western frontiers of the Belur-tag mountains, which to a considerable distance, but not uniformly, form the western boundaries of Little Bukharia; and the source of the Indus has been traced nearly as high as the 40th parallel of north latitude. We, therefore, contemplate the primitive settlement of the aboriginal *Seres*, or the ancient *Serica*, or *Sereinda*, as the same country; and about five degrees to the south, but on the same meridian with the present city of Cashgar; and consequently between the sources of the Indus on the west, and the Belur-tags on the east. And sections of this original colony might subsequently migrate to Hindoostan on the south, or to China on the east. Whether this was the cradle of the first silk culture or not, the general interest, in process of time, would naturally set in with the tide of migration and move easterly, until we find the great emporium within the limits of the Celestial Empire.

Here, doubtless, the *Seres* would be in the time of so late a Roman writer as Ammianus Marcellinus, quoted by Dr. Lardner. "Marcellinus describes the Seres as a sedate and gentle people, who avoid all contentions with neighbouring nations, and are, therefore, free from the miseries and alarms of war. Being without the necessity for using offensive weapons, they are even unacquainted with them. Blessed with a fertile soil, and a delicious and salubrious climate, they are represented as passing their happy days in the most perfect tranquillity and delightful

leisure, *amid shady groves fanned by gentle breezes, and producing fleeces of downy wool, which after being sprinkled with water, is combed off in the finest threads, and woven into sericum.*" Marcellinus proceeds to describe the Seres as being content with their own felicitous condition, and so reserved in their intercourse with the rest of mankind, that when foreigners venture within their boundaries for wrought and unwrought silk, and other valuable articles, they consider the price offered in silence, and transact their business without exchanging a word: a mode of traffic which is still practised in some eastern countries. How nearly this corresponds to the singularly immutable manners of the Chinese of the present age, is sufficiently obvious.

But would we know what account the Chinese themselves give relative to the earliest introduction of the silk culture, we shall find it in the French version of the Chinese Treatises, by M. Stanislas Julien, or in the following words of p. 77 and 78, as translated and published in 1838, at Washington, under the title of "Summary* of the principal Chinese Treatises upon the Culture of the Mulberry, and the rearing of Silk Worms."

"In the book on silk worms we read—the lawful wife of the emperor *Hoang-ti*, named *Si-ling-chi*, began the culture of silk. It was at that time that the emperor *Hoang-ti* invented the art of making garments."

"*Observations by the Translator.*—The same fact is mentioned more in detail in the general history of China, by P. Mailla, in the year 2602† before our era, (4438 years ago.)"

* "This Summary was first translated from the Chinese, by M. Stanislas Julien, member of the French Institute, and Professor of Chinese Literature in the College of France, and printed at the royal press in Paris by order of the minister of public works, agriculture, and commerce. The French copy from which this translation was made, was transmitted from Paris to the secretary of state, and by his recommendation has been translated and published at Washington."

† Not 2700 B. C. as commonly repeated.

"This great prince, Hoang-ti, was desirous that *Si-ling-chi*, his legitimate wife, should contribute to the happiness of his people. He charged her to examine the silk worms, and to test the practicability of using the thread. *Si-ling-chi* had a large quantity of these insects collected, which she fed herself, in a place prepared solely for that purpose, and discovered not only the means of raising them, but also the manner of reeling the silk, and of employing it to make garments."

"It is through gratitude for so great a benefit," says the history, entitled *Wai-ki*, "that posterity has deified *Si-ling-chi*, and rendered her particular honours under the name of the *goddess of silk worms.** (Memoirs on the Chinese, vol. 13, p. 240.)"

* Whatever of these extracts is important we shall, in the notes, introduce, in the proper place; and take this opportunity to observe, once for all, that no doubt to many the Chinese prescriptions will frequently appear to be blended with superstition, or with what we should have thought too trifling for the sense and science of a people of 4000 years. But since M. Camille Beauvais's well known enthusiasm for the introduction of improvement in the culture of the mulberry and rearing of silk worms has led him to commend, in almost unqualified terms, whatever the Chinese say on the subject, we shall, wherever occasion requires, introduce their rules as we find them, leaving it to the reader's judgment and experience to determine what is unnecessary.

On this subject, we quote as follows from the preface to the American edition. "Notwithstanding the superiority of the French in the arts and sciences, and length of time which has elapsed since the introduction of the manufacture of silk into France, (in the reign of Francis I.,) the fact of the great superiority of the Chinese culture is frankly admitted by M. Camille Beauvais, the gentleman at whose instance the French minister directed the translation to be made from the Chinese works. Such is the strength of his testimony on this point, that he asserts, "THE CHINESE LOSE IN THE REARING SCARCELY ONE PER CENT. OF THEIR WORMS, WHEREAS THE FRENCH LOSE MORE THAN FIFTY!"

"Some minds, influenced by ancient traditions," says M. Beauvais, "will perhaps consider this multitude of trifling attentions, which the Chinese lavish upon the silk worms as childish; others will only see some proceedings little different from theirs in appearance, or will say, that they may be proper to the climate of China, and not applicable in ours. But time and experience will, I hope, cause these natural methods, these delicate attentions, these wise and multiplied precautions, the Chinese authors recommend to be appreciated at their just value."

We have here an example of the good sense, which, in this respect at least, the Chinese have evinced not only in primeval but also in subsequent times. The attention of the "powers that be," do not seem there

After this explanation we shall add the most important points from the translation of these Chinese works now before us.

"It is written in the Book on Worms," one of the five canonical books, chapter *Pin-fong*, Ode I., "In the month when the silk worms are fed (fourth month) the leaves of the mulberry trees must be gathered." 'This chapter was composed by *Tcheou-kong*, uncle to the emperor *Tching-wang*, 1115 years before our era.'—St. Julien.

"We read in the Li-ki, or book of Ceremonies, one of the five canonical books, in the chapter Youei-sing:

'In the last spring month, the young empress purifies herself, *and offers a sacrifice to the goddess of silk worms*,' (very important!) 'She goes to the fields, situated to the east, and gathers mulberry leaves herself. She forbids the noble ladies and ministers' wives all ornamental dress, who sew and embroider, so that they may be able to give all their attention to the raising of silk worms.'

"The Li-ki, or book of Rites, from which this passage has been extracted, was compiled by Confucius, whose birth was 551 B. C."

"In the work entitled *Nong-sang-thong-kioué*, we read:

'The place called *kien-kouan*, (or the house of cocoons,) is that where the empress herself raises silk worms. In ancient times, there was a plantation of mulberry trees, belonging to the state, and a building called *Tsan-chi*, (or the house of the silk worms,) which had the same destination, which is now designated *kien-kouan*, viz. the house of cocoons.

'The young empress *purifies herself*, and *offers a sacrifice to the goddess of the silk worms*, as an example to the whole empire, and to promote the general culture of silk. The empress repairs to a mulberry plantation. She first cuts *a branch*; an attendant who holds a basket, receives the leaves; afterwards the empress cuts *three branches. A maid of honour, endowed with the title of Chang-chou*, (or president,) *throws herself on her knees, and says, it is enough.*' (Does M. Beauvais wish all this to be attended to!) It is forbidden to carry the leaves to that part of the palace called Ken-chi, or golden house."

"The author of the work entitled *Nong-song-thong-kioué* continues to quote some analogous facts, which he had gathered from the history of the emperors, from the years of *Thien-pao*, 968, of the dynasty of *Song*, under which he lived, so as to show, that from the highest antiquity, the empress raised silk worms as an example to the whole empire."

"In the work entitled *Tsan-lun*, or Considerations on the silk worm, we notice:

"Every species of tree requires a particular soil, except the mulberry tree alone, which grows everywhere, and consequently there is not a single place in the empire where silk worms cannot be raised."

so much directed either to support and extend society in an artificial condition, or in political wrangling and intrigue; but in the promotion of that natural and salutary state, which can only be maintained by a due proportion between production and consumption, especially in reference to every agricultural department. And, therefore, in this, the productive class is encouraged by imperial or royal sanction and patronage. We have, therefore, before us, an historical demonstration of the felicitous consequences of such a polity: whilst it has in all ages of that vast empire contributed to the comfort and consequent peace and content of the many millions subject to its government, it has by the same means combined the immense plains of Chinese interests into one consolidated system of independence and wealth.

This policy, found profitable at first, was continued through a succession of generations too numerous for even history to comprise; and royal sanction and patronage were perpetuated through a long line of the empresses of 4000 years. The fair sex of all ranks did not fail, under such fostering auspices, to copy a precedent at once honourable in its character and profitable to themselves. The example of encouraging domestic industry was shown by the emperor and princes, mandarins, courtiers, and all orders became clothed in silk. Thus China, at an early period, was in possession of a secret that European nations have not learned to this day: that the full encouragement of home produce and manufacture is of far greater consequence than foreign trade.

Such is the wise and steady course that has been

This seems confirmed, since in the same notes we find the following provinces of China where silk is raised, viz. *Si-gan-fou*, which is now the capital of the present provinces of *Chen-si*, *Honan*, *Chan-si*, *Hou-nan*, *Chan-tong*, *Hou-kouang*, *Ssé-tchouen*. There are similar short and detached historical notices relative to the years 163 B. C., 156 B. C., 18 B. C., 58 A. D., 220 A. D., 265 and 275 A. D., 454 and 457 A. D., but none of them contain any thing important to Americans or new or unknown, as to the culture, to moderns, except such peculiarities as we have already specified.

exemplified and transmitted from emperor to emperor, and from empress to empress. It seems to declare to the world that the permanency of nations cannot exist, except where the interest of the government and that of the people is such as to be identical. It is not the theory of a political economist, but an experiment that has been tested by centuries. For its verity time himself has been appealed to, and has given a verdict that is a salutary lesson to those that have neglected it. Its utility and profit to the individual and to the nation have been too reciprocal to require distinction, and as changeless as the necessities of man.

A state occupied in the pursuits of war, or in international feuds and distraction, is embarked in the career of national hazard and popular suffering. But the emperor, prince, or government, monarchical or republican, that smiles on the amenities of peace, by extending its fostering energies collaterally with the wants of man, and encourages production proportionate to necessity, adopts a policy which has the highest claim of any thing secular to perpetuity. Thus an adequate impetus is given to industry; national broils are merged in the prospect of domestic comfort, and dissatisfaction is exchanged for contentment; salutary habits are instituted; new prospects are introduced and urged; and reciprocal interests are national sinews. To promote this, a spring is bent of *imperial* steel: and what is the consequence? The mulberry, the orchard, the plantation, and even the very insects are put in requisition. An easy, a pleasant, and a profitable mode of employment is established suitable to all ranks, all ages, and constitutions. In this, industry becomes nobility and imparts it. The emperors, the empresses, princes, mandarins, courtiers, the affluent, the learned, all, were in the ranks. National and home wants were supplied; commerce lends her wings; ships and caravans moved; oceans and seas gave their aid, and deserts looked gay; solitudes, if not made to blossom, were

seen to smile; the Parthians, the Hindoos, the Persees, the Arabs, the Syrians, the Phœnicians, were converting the wastes of Asia into the panorama of activity: all western tribes were seen in travelling communities, and the "wealth of the Indies" became a proverb current as far as the shores of Colombia. Thus China has stood as a monument, with the age and firmness of a pyramid, to testify to the world, that whilst many states have felt the alternate favours and caprice of fortune, or have fallen as suddenly as they rose in the scale of nations, she, by pursuing a policy differing from all, has stood the test of 4000 years.

This career of industry and domestic production found so beneficial at first, is continued to the present. By adverting to the preface of the Washington edition of the Summary we have mentioned, we read that, "the egg of this insect exceeds not the size of a grain of mustard seed, yet so amazing are the results, that the proceeds of its industry actually constitute the chief source of wealth to the most populous, and perhaps the richest nation of the globe. In the language of a French writer, 'If the cocoons in China were collected together they would form mountains.' The two provinces of Nanking and Chakiang, alone send every year to the court three hundred and sixty-five barks laden not only with pieces of wrought silk, satins, and velvets of various kinds and colours, but even with rich and costly garments of the same material." If two provinces, only, annually send this quantity, and that merely to the court, what all the provinces transmit not only for national consumption, but to the other parts of Asia, and to the rest of the world, we may conjecture, but cannot estimate.*

* The singular mode by which weaving or the manufacture of silk fabrics is conducted in some parts of China, is thus narrated at page 18 of vol. 1, of the Silk Culturist.

"Silk looms in Europe are of the most simple construction, but when contrasted with the contrivances in India, would seem to give them a decided advantage. In India, the weaver weaves his web in the open

It is a singular mystery attached to the history of the culture of silk, "that before silk worms were brought to Constantinople, in the middle of the sixth century, no person in that capital," nor apparently beyond the precincts of China, "knew that silk was produced by a worm."* Notwithstanding this, not only were silk fabrics transmitted to distant nations, but also the raw material, which employed manufactories in Persia, Tyre, Berytus, and in Cos, an island of the Archipelago.† It is obvious that had the use

air. He first selects a station for his work, generally under a tree, that its foliage may protect him from the scorching rays of the sun. He then extends the threads which compose the warp of his intended fabric lengthwise between two bamboo rollers, which are fastened to the ground by means of wooden pins. He then digs a hole in the earth large enough to contain his legs in a sitting posture. He next attaches to a limb of the tree, the cords by which his harness is to be worked, and to the lower shafts of the harness cords with loops of sufficient size to admit the insertion of his great toes. With his web thus arranged, he is prepared to commence weaving. This he does by putting his toe into the loop of the cord attached to that part of the harness which he wishes to tread down, and then with a shuttle introduces the woof and beats up by striking the threads of the woof with the shuttle instead of a batten. The shuttle is in the form of a netting needle, and longer than the breadth of the web. With this rude apparatus he manufactures a fabric of which an Italian silk weaver would be proud. If the silk manufacture in China is so simple, and is so easily performed without the aid of complicated machinery, can it not be successfully prosecuted in a country abounding in machinists, with ingenuity to invent, and skill to execute the most perfect machinery in the world?

* Theophanes and Zonaras, the Byzantine historians quoted by Dr. Lardner.

† Chateaubriand, in his travels, speaking of the isle of Zea, says, its present commerce are acorns and silk. "The silk gauze worn by the ancients was invented at Ceos," the ancient name of Zea. "The poets, to convey an idea of its fineness and transparency, called it *woven wind.* Zea still furnishes silk." "The women of Zea," says Tournefort, "generally assemble in companies to spin silk, and they seat themselves on the edge of the terraces at the top of the houses, that they may drop the spindle down to the street, and draw it up again as they wind the thread. In this attitude we found the Greek bishop: he inquired who we were, and told us that our occupations were extremely frivolous, if we came only to look for plants and old pieces of marble. We replied, that we should be much more edified to see him with the works of St. Chrysostom and St. Basil in his hand, than twirling the spindle."

The island of Zea or Ceos and Cos have been confounded; the latter is 200 miles from the former up the Levant. Tibullus, Horace, and

of the silk worm been known at that island, the source from which silk is derived would also have been known at Byzantium. It is at the island of Cos, however, that not only the *manufacture* of silk is reported to have been first known in the west, but of a peculiar species of it. Pamphila is reputed to have been the inventress. According to the testimony of Aristotle, *bombykia** was respun and rewoven at this island. The imported fabric seems to have been so costly as to form an inducement to Pamphila and her associates to unweave the precious webs in order to convert the substantial stuffs of Serica into a more extended surface, or into a thin transparent gauze; and thus to gain in measure what was lost in substance. This Pamphilan expedient was subsequently imitated by the Roman ladies, amongst whom the foreign article seemed to have been one of increased value, since it was the chains only of their rewoven fabrics that were allowed to be of silk, the interstices being filled up with linen or cotton, constituting a sort of half silk stuffs. Yet, though the more costly material of the mixture was thus attenuated, it did not prevent the subsequent outcry against it, as too extravagant an article for dress.

For centuries Persia seems to have enjoyed the monopoly of the trade with India and China; though, in later times, it is reported, that caravans were passing direct from the coasts of China to Syria, occupying a period of two hundred and forty-three days in the transit; whence the wealth of the Indies was further transmitted by Arabs and Phœnicians to more western parts. Notwithstanding all this intercourse, and the curiosity that interest must naturally have excited relative to the origin of silk, yet it appears, through that finesse and subtle policy, which consti-

others make Cos, and not Ceos, the place where silk gauze was anciently manufactured; but common opinion is in favour of Ceos, and the fact that the business is still carried on at the latter place to a considerable extent is strongly in its favour.

* The fabric produced from the *Bombyx*, or silk worm.

tute the national characteristic of the Chinese to the present day, the western part of Asia, and Europe, were kept in profound ignorance on this important topic, until the secret was elicited by stratagem in the sixth century. Notwithstanding the contumely with which the character of Aristotle has been treated by those who never either read him, or were disposed to make candid allowance for the comparative darkness of the times in which he lived, he appears, in the investigation of truth, even as to the silk worm, to have been on the advance, not only of his cotemporaries, but, for 800 years, of those that succeeded him. It was fortunate for philosophy that his influence, as a preceptor, was prevalent with Alexander. In conformity to his advice, he took out with him, on his Asiatic expedition, 1000 men, whose exclusive commission was to make collections in the several departments of zoology, and to transmit them, from time to time, to the Grecian naturalist: to which were added, on the return* of the victorious army of Alexander, amongst other eastern luxuries, wrought silks from Persia. Aristotle, therefore, seems to have been thus enabled to give, though without naming the country of its origin, the most accurate account of the silk worm, describing it as a horned insect, passing through successive transformations and producing *bombykia*.

Neither does Pliny seem to have been unacquainted with the silk worm, though his description differs materially from that of the Grecian philosopher; but of its use he evinces a total ignorance, since he affirms that the fabrics unravelled and rewoven by the Roman ladies, were the proceed of a woolly substance combed from the leaves of trees to form the draperies made and exported by the Seres. Assyria,† however,

* A. M. 3678. B. C. 326.

† Justin relates that Sardanapalus (A. M. 778) emperor of Assyria, never left his palace, but spent his time with women and eunuchs spinning with them at the distaff. Had it not been for the late period, when the use of the mulberry and silk worm was known at Constan-

he assigns as the country indigenous to the insect he describes, and names Ceos (not Cos) an island of the Ægean sea, as the seat of Pamphila, and the singular manufacture of which she was the inventress.

With the exception of the two naturalists already mentioned, ancient writers,* for nearly nine centuries, not only evince complete ignorance relative to the origin of silk, but also betray the most crude conceptions as to its production. At one time it was imagined that *Sericum* was made either from fleeces growing upon trees,† or from bark, or flowers; at another that the silken filament‡ was the proceed of a species of spider or beetle. A strong interest must have existed somewhere to have kept the whole of this a secret; and persevering, indefatigable, and vigilant must have been the policy to have maintained it such for so many centuries. Here we see a trait of the Chinese, in which they stand unequalled, and without a parallel in any other nation.

This, together with other circumstances, will enable us, in some degree, to account for the extreme scarcity, for many centuries, of silk in Europe. So costly was this article of luxury, that all knowledge of it was chiefly confined to Rome, or to other cities of princely

tinople, charity, aided by this account of Pliny, would have inclined us to attribute that as a virtue to this monarch, especially when his age at the time is considered, which has been commonly imputed as a vice; or to suppose that he and his attendants were engaged at that period, on the banks of the Tigris, in the laudable pursuit of producing silk; and, therefore, not suited to the military taste of Arbaces governor of Media, and affording an opportunity to the rapacity of Belesis, governor of Babylon.

* Nearchus, Aristobulus, Theophrastus, Virgil, Dionysius, Periegetes, Seneca, Arrian, Solinus, Ammianus Marcellinus, Claudian, Jerome, &c.

† "Vellera ut foliis depectant tenuia Seres."—Virgil.

‡ "I have long entertained the idea that the golden fleece which Jason carried from Colchis, was a cargo, or perhaps only a skein of rich golden coloured raw silk in the hank, which might figuratively be termed a fleece, because it was to be twisted into thread and interwoven into cloth. This at least is as plausible as the commonly received solution admitted by a celebrated historian not prone to credulity."—Note to Martin's Translation of the Travels of Marco Polo, quoted by Dr. Lardner.

residence. Before the reign of Augustus,* there is little or no mention of it; and its use, in that of Tiberius,† was restricted by sumptuary laws to women of rank and fashion. Though this prohibition did not, in summer, apply to the use of the lighter fabrics of Cos by the men; yet their extreme tenuity or transparency, as an article of apparel, whether worn by men or women, met the frowns, though with but partial success, of the Roman satirists‡ for more than a century.§

Rome was at this time rapidly increasing in wealth, and therefore in luxury. The demand for silk, as a consequence, was no longer commensurate with the scanty supply, and the price became exorbitant. To obtain relief, or a more direct commercial communication, an embassy, by way of Egypt and India, was sent, in the second century, by Marcus Antoninus.‖ The Chinese annals testify, that the changeless polity of that country treated then, with the same reserve, as it does now, all applications for foreign intercourse, except through channels of long and tried fidelity. The Persians, therefore, retained for centuries the Indian monopoly, and their caravans laden with its wealth traversed the wilds of Asia from the Celestial Empire to the shores of Syria.

Had we no other proof that this state of things, for some time, continued on the increase, that relative to the Syrian voluptuary Heliogabalus,¶ would be sufficient; of whose extravagance, after the Roman writers have mentioned the particulars, they add, as a climax in the list of his criminality, that he wore a *holosericum*, or a garment altogether made of silk.

It is added likewise as a further proof to the same

* B. C. 31. † A. D. 14.

‡ Publius Syrus, Varro, Tibullus, Propertius, Horace, Seneca, Pliny, and Juvenal. Pliny, l. xi. c. 23. Tacit. Ann. l. ii. c. 32.

§ According to the testimony of different writers, silk was not unfrequently seen at Rome as early as in the reign of Tiberius, A. D. 17. Galen, A. D. 173, mentions that the scarcity of silk was such that it could be worn only by the rich.

‖ A. D. 177. ¶ A. D. 222.

purpose, that Aurelian* assigned as a reason for his refusing his empress a similar luxury, that its cost would be equal to its weight in gold.

It is easy to perceive the advantage which this passion for dress, that, of course, accompanied the Romans to Constantinople, offered to the Persians, at that time in the unimpaired possession of their monopoly. Neither was it without a liability to disappointment to the Romans on the one hand, and to the final loss of the trade to the Persians on the other. In availing themselves of the advantage, the latter, either by the exorbitant prices imposed by the merchant, or by the exactions of government, evinced that gross indiscretion which was ultimately destructive to their interest. And to this, when there was added a war between the two countries, a different mode of procuring supplies, became, on more accounts than one, imperatively necessary.

A war with the Persians occurring in the reign of Justinian induced that monarch to obtain supplies from a more eligible channel. Through a deficiency of the requisite experience and qualifications necessary for so difficult an undertaking, Elasbaan king of Axuma, and Esimiphæus governor of the Homerites in Arabia, to whom, for this purpose, Justinian had made application, failed to fulfil their engagement; and silk, in consequence, rose at Constantinople to a height before unknown. This, the partial supplies, usually afforded by the Phœnician manufacturers would have considerably relieved, had not Justinian with a blind rapacity, that, in his aim to augment the revenue, effectually defeated itself, imposed heavy duties on the importations, which became absolutely prohibitory.† In consequence the merchants were ruined, the scarcity of silk was equivalent to absolute privation, and the failure of a

* A. D. 273.

† The *nominal* price of silk per pound at this time, may be quoted as equivalent to 22·98, which, however, was but trifling to the *real* value, when the difference of the times is considered.

revenue whose increase was contemplated by Justinian, was a practical sarcasm on his avarice.

Thus have we, in the history of silk, arrived at a very important and ever memorable CRISIS. Silk was produced even from the earliest ages, in regions congenial to its culture, where in consequence of the blessings it confers, the inhabitants proclaim themselves *celestial*, but assiduously withhold all knowledge from what the benefit is derived. An insect, as if in some land of enchantment, labours, spins, and dies; and without leaving itself even a sarcophagus, bequeaths its house, more valuable to man than the proud monuments of the Egyptian architect, its robe more golden than Jason's fleece, and all its estate, by the bale and cargo, to the men of Hesperian climes, who know not either of its existence, nor the mystery of its operations. The elegance of the fabrics is admired by all; Europe invites the commerce; a difficulty unmanageable in the ordinary course of things occurs; a crisis arrives; THE OLD EPOCH IS CLOSED, and a NEW ERA, most important in its history ARRIVES.

How frequently has relief come, not only at the moment of extremity, but by the most unexpected means. Justinian failed in his diplomatic application to the Arabian princes, as well as his predecessor had done at the Chinese court; and his very attempt to force a trade was the means of its almost total extinction. But how could it have been foreseen, that what emperors, ambassadors, and merchants failed to accomplish, would be effected by means so unlikely as by two comparatively obscure Nestorian monks?

The preachers of the doctrines of Nestor, exiled by the government of Byzantium, had fled to India; and missions, convents, and bishoprics, by their patriarch resident in Persia, had been, according to the testimony of Cosmas, established in every direction. Two of the monks penetrated to the country of the Seres. With curious eye they had observed the dress of the Chinese; the manufactures of the silken fabric;

and the millions of insects, whose education was the labour of queens, converting the leaves of a tree into silk. All the manipulations requisite, from the embryo state of the little animal, to the production of the costly material, were marked with intense interest. The secret was out! two monks in possession of it—the knowledge to benefit myriads was entrusted to two—the perils in traversing a vast continent were yet to be encountered—a risk was to be incurred—no insurance was effected, but that of Providence: thus all was safe: and the two monks, our benefactors, bequeathed a mystery hid for ages, as a legacy to a western hemisphere.

Aware of the solicitude of the Europeans on this subject, the monks repaired to Constantinople, and revealed to the emperor the secret that silk was produced by insects whose eggs might be conveyed to his dominions. Were we to indulge in the conjecture what, most naturally on such a momentous occasion, was the passion chiefly excited in Justinian, at this important juncture, when a report, than which none could be more interesting to the secular concerns of man, was first announced to his ears, our charity might have inclined us to point to philanthropy, had we not ascertained the character of the man. With him, on several occasions, self was a universe, and all within it his minions, whose interests were to be consulted precisely to the point where they served his own. By the promise of a great reward, the monks were induced to return to China, elude the vigilance of that jealous people, obtain the eggs, and to confine within the narrow precincts of a hollow cane, what was subsequently to create machines and factories, fill warehouses and ships, and become inexhaustable mines of wealth to nations. They succeeded; and in the year 552, they were in Constantinople, and their cane, like Noah's ark, contained a family, whose posterity are now filling regions wider than those peopled, within the same time, by Shem, Ham, and Japheth.

"The insects thus produced," says Dr. Lardner, "were the progenitors of all the generations of silk worms, which have since been reared, in Europe, and the western parts of Asia;"—to which we may now add, Africa and America—"of the countless myriads whose constant and successive labours are engaged in supplying a great and still increasing demand. A caneful of eggs thus became the means of establishing a manufacture which fashion and luxury had already rendered important, and of saving vast sums annually to European nations, which in this respect had been so long dependent on, and obliged to submit to, the exactions of their oriental neighbours."*

No sooner is this new and interesting colony in Europe, than the avarice of Justinian seizes the cradle of the infant concern. His own treasurer had the control, the monks the direction, weavers brought from Tyre and Berytus were the creatures of the monopoly, and his became the prerogative to fix the price which his subjects should pay for the indulgence of their vanity. The price of silk, by this means, became eight times more expensive than before the introduction of the silk worm: an ounce weight of a fabric of common colours could not be purchased for

* The authorities quoted, on the whole of this part of the subject, by Dr. Lardner are, Robertson's Disquisitions on the Commerce of India. D'Herbelot Biblioth. Orient. art. Harir. Procopius, Hist. Arcan; and de Bello Gothico, l. iv. c. 17, Theophan. Byzant. apud Photium. Theophylact. l. viii. et apud Photium. Zonaras, vol. iii. p. 50, edit. 1557.

"The eggs were hatched in the proper season by the warmth of manure, and the worms were fed with the leaves of the mulberry. In due time, they spun their silk, and propagated under the careful attention of the monks; who also instructed the Romans in the whole process of manufacturing their production."—Id.

In the Silk Grower for September, 1838, it is added, that the monks "brought with them minute instructions for hatching the eggs, rearing the worms, reeling, spinning, and weaving the silk. But they made but little improvement. Cocooneries were then unknown; hurdles and other necessary conveniences not thought of. The worms fed on the ground, allowed to wind their balls amongst the rubbish of six weeks' collection; and then reels were entirely useless, being too complicated to be used except by rich manufacturing companies."

less than six pieces of gold, but the royal purple was of quadruple value.

Fortunately for the public good, the oppressors of mankind live not for ever: Justinian died; and the monopoly ceased. The people of western Asia and Europeans discovered that neither the mulberry nor the silk worm, wanted either Chinese climes, or the care of a Justinian to foster them. Mulberries were planted in all directions; and the insects fell to work with haste as eager, as if they had never known that their ancestors had been silk worms royal to his highness Justinian.

After the death of the emperor* we shall find the culture and manufacture of silk transferred to Greece, especially Peloponnesus, and to the cities of Athens, Thebes, and Corinth. Soon after the Venetians entered on commercial relations with the Grecian empire, and conducted the carrying trade, for several centuries, to the western parts of Europe. Such was the estimation in which this manufacture was then held, as appears from the example of Charlemagne in the year 790, sending two silken vests to Offa king of Mercia, that it was considered worthy of being made a regal gift. Greece, notwithstanding all discouragement consequent on the continued and rapid decline of the Roman empire, continued to excel all other nations of Europe in the quality of her manufactures. She alone, for near 600 years, possessed the valuable breed of silk worms; soon produced wrought† silks adequate to her own consumption; a recourse to Persia for a supply ceased, and a material change took place in the intercourse with India.

* A. D. 565.

† Modern silks, as velvets, damasks, and satin remained as yet unknown.

CHAPTER III.

SUBSEQUENT HISTORY OF SILK,

FROM THE PERIOD WHEN SILK WORMS WERE FIRST INTRODUCED INTO EUROPE, CONTINUED AS TO EACH NATION DISTINCTLY; CHINA; ARABS, TARTARS, TURKS; TURKEY AND PERSIA; HINDOOSTAN; EGYPT.

HAVING, in the preceding chapter, pursued our history until the time when silk worms were first introduced into Europe, and a manufacture commenced within the precincts of the Greek empire, we shall now, since the subject becomes more strongly marked and distinct, consider the sequel as to each nation singly, and resume our inquiries relative to CHINA.

The silk worms had arrived from India, and Grecian industry had been employed at a season not too early to render, by establishing new resources in the west, European admirers of the silken robe independent of oriental supplies: for when Canfu, the Chinese port for the resort of foreign merchants, fell, in the year 877, into the hands of the savage rebel Baichu, he not only massacred all the inhabitants, amongst whom, it is reported, there were 120,000 merchants, comprising Mohammedans, Jews, Christians, and Persees, but also extended his cruelty to the very insects on whose productions the natives depended, destroyed the trees necessary to their existence, and in addition, imposed such exactions on foreign intercourse, that the Chinese trade, for threescore years, seems to have been completely annihilated. And it did not recover, according to the testimony of Massoudi, from the infernal tempest of this eastern maniac, until 938, when Canfu once more became a place of mercantile resort.

The Venetian nobleman and celebrated traveller, Marco Polo, at the close of the thirteenth century, gave to the world one of the most interesting accounts which the middle ages produced, in which he furnishes a narrative of his travels in the Celestial Empire, and over the Asiatic interior. "No fewer," he says, "than 1000 carriages and pack horses, loaded with raw silk, make their daily entry into the city;* and silks of various textures are manufactured to an immense extent." Great, rich, and crowded cities, filled with manufacturers of silk and merchandise, covered the whole extent of China.†

We are all aware that climate is a matter of first importance, in the growth of the mulberry, and in the raising of silk. In this respect, it is evident, that China is particularly favoured, when it is considered, that the latitude of her metropolis, Peking, 39° 54', about 3 miles more to the south than Philadelphia, may be quoted, being within 100 miles of the great wall, as the northern extremity of her silk growing country, which thence extends to the south as far as to the 20th parallel of north latitude. But it is in her central provinces, between the 25th and 35th degrees of latitude that the greater part of the silk is produced.

* Cambalu, then the name for the royal city.

† "According to Cosmas, the Indians who traded with the Chinese, were accustomed to resort to Ceylon, where alone they received silks, spices, and other valuable productions, which were thence distributed among the different marts of India. Gibbon, in the fifth volume of the 'Decline and Fall of the Roman Empire,' thus describes the mode of prosecuting this commerce: 'The Chinese and Indian navigators were conducted by the flight of birds, and periodical winds, and the ocean might be securely traversed in square built ships, which, instead of iron, were sewed together with the strong thread of the cocoa nut. Ceylon, Serendip, or Taprobana, were divided between two hostile princes; one of whom possessed the mountains, the elephants, and the luminous carbuncle; and the other enjoyed the more sordid riches of domestic industry, foreign trade, and the capacious harbour of Trinquemale, which received and dismissed the fleets of the east and west. In this hospitable isle, at an equal distance from their respective countries, the silk merchants of China, who had collected in their voyages, aloes, cloves, nutmegs, and sandal wood, maintained a free and beneficial commerce with the inhabitants of the Persian Gulf.'"—Dr. Lardner, p. 256, note I.

It is also well known that an accurate estimate of temperature cannot always be made by inferring the climate of one place from that of another of the same latitude on a different meridian, without referring to the isothermal* lines. The eastern shore of North America, is, in this respect, so similarly situated to the same shore of the Asiatic continent, that the mean annual temperature of any given degree of latitude on our Atlantic shores, will be found very nearly to correspond with the mean annual temperature of the same degree of latitude in China near the Pacific. China also, in point of extent of surface and territory very much resembling those of the United States, it is evident that we, of all nations under the sun, have the greatest chance to equal that eminent nation as to the golden fleece. Nature has done all she could do for us, in this respect; will a sound policy and a salutary government effect the rest?

In the Washington version of M. Julien's Translation of the Summary already mentioned, a note is given from M. E. Biot on this subject, as it refers to the temperature of this vast country not inaptly termed the *silk empire;* a name of some importance to us should we, so similarly circumstanced, become *silk empire the second.* That part of the note which refers to isothermal relations, as in this respect the United States are correlative to China, it is unnecessary to quote; but all that we have found in M. Biot's remarks, said to be derived from the observations of La Perouse, Amyot, Lord Amherst, and missionaries long resident there, on the subject of mean temperatures, we have reduced from the ratio of the centigrade to that of Fahrenheit, as stated in the following table.

* Or lines of *equal* temperatures in *different* latitudes of the same hemisphere. A variation effected chiefly by the prevalence of northwesterly wind, sweeping the chilling blasts of frozen plains on the north of large continents to their eastern shores. So that the western extremity of an isothermal line will be from 10 to 15 degrees more to the north, than the eastern extremity on the same continent.

MEAN TEMPERATURES IN CHINA.

North Latitude.	Cities.	Mean Temperature of the warmest month.	Mean Temperature of the year.	Mean Temperature of the coldest month.
39° 54′	Peking.....	84·3	54·8	39·2*
32° 45′	Nangasaki	86·9	60·7	43·7
23° 8′	Canton.....		73·2	
22° 12′	Macao.....		74·0	59·5

We regret that the testimonies adduced do not enable us to fill our columns, and prefer leaving the blanks for the reader to supply from authentic documents.

As a further proof that any latitude in the United States is nearly isothermal with the same latitude in

* Some error is suspected here. "The summer at Peking," says the note, "is like that of Naples, whilst the mean temperature of the coldest month is 4°; and the thermometer remains there for 3 months below zero." Now M. Biot's temperatures are those of the centigrade, $\therefore \frac{4 \times 9}{5} + 32 = 39°\ 2'$ of Fahrenheit, the mean temperature of the coldest month, which is such that it is not likely to be for 3 months below zero. Yet there is no observable discrepancy between that mean, and that of the same month at Nangasaki, the difference of latitude considered.

We further extract from M. Biot's note as follows. "In 1820, at Timkowski, in Mongolia, in 40° to 45° of latitude," (same as from the latitude of Philadelphia to that of the southern part of Maine,) "in the month of October and November, the thermometer descended from 10° to 15° below zero = 18° to 27° of Fahrenheit." A French missionary established in 1833 in East Tartary, at Si-wang, in 41° 39′ of latitude, relates extraordinary differences between the temperature of summer and winter. According to him the thermometer rises to 37° 5′ centigrades in summer (99·5 Fahrenheit) and descends to 37·5 below zero in winter, (67·5 Fahrenheit.) "During this last season," say the Annals of the Propagation of Faith, Nos. 40 and 50, "spirits of wine only remain liquid; and when a metal is touched with moist hands, the epidermis of the fingers remains attached thereto." In conclusion, a useful remark on the temperature of the central provinces is furnished us by a misssionary who has lived 10 years in China, and which limits the cultivation of the orange to the 30th degree of latitude," (corresponding to our oranges at St. Augustin, in Florida, latitude also 30°,) "while in Provence, (France,) we have oranges as high as the 43d degree."

China on a meridian equidistant from the eastern shore, and that for any season of the year, we shall further quote the following examples. Philadelphia is in the same latitude as Peking, and nearly equidistant from an eastern sea. The mean annual temperature of the former is 53·7; of the latter 54·8. At Nangasaki, latitude 32° 45', and at Augusta in Georgia, nearly in the same parallel, and as near the eastern sea as any place of that latitude in the United States of which we have any thermometrical record, the comparison may be stated as follows:

North latitude.	Cities.	Where.	Mean Temperature of the warmest month.	Mean Temperature of the year.	Mean Temperature of the coldest month.
32° 45'	Nangasaki	Kiusu	86·9	60·7	43·7
32° 35'	Augusta	U. S.	83·0	67·0	46·0

The differences being slight are referable to local causes. This, however, is sufficient to show the striking resemblance of the climates of the two countries. The subject is important: China long has been the first silk growing country in the world; our favours in point of climate are equal; in other respects greater; and, therefore, whatever the Chinese can effect, we can accomplish likewise. We further learn, that the raising of silk worms, commences there in April, when the air is sufficiently warm; though in the more northern provinces, the development is aided artificially by heat. The cold in winter in these provinces seems very rigorous, yet the mulberries do not freeze.

Du Halde says, "Everybody knows the abundance and beauty of the silk made throughout China." Dr. Lardner adds, "the ancients showed their knowledge of this abundance, when they called it *the kingdom of silk;* and the moderns know it from experience. For many nations both of Asia and Europe draw

from it the superabundance of its produce; and every year, ships and caravans leave the country, laden with vast quantities of the wrought and unwrought material. Yet although thus lavishly sent forth, still, such is the amount produced, that silken fabrics, either of the simple material, or mixed with gold or silver, are consumed throughout the empire to an almost incredible amount. To this evidence may be added the many hundred thousand pounds of wrought and unwrought silk which the provinces annually pay as tribute to the emperor."

The largest quantity of silk in China is produced about the neighbourhood of Nan-king, or the latitude of 32°. The production of silk furnishes in that empire employment to a greater number of individuals than any other avocation. England imports a vast quantity of both raw and wrought silks from China. The amount of the latter kind, being brought by the East India Company's ships, is not known. But of raw silk only from China, England imported in the year 1829, 600,000 pound's weight. Dr. Lardner observes, that "fourteen thousand millions of animated creatures annually live and die to supply this little corner of the world (England) with this article of luxury! If astonishment be excited at the fact, let us extend our view to China, and survey the dense population of its widely spread region, a population that from the emperor on his throne to the peasant in the lowly hut, are indebted for their clothing to the labours of the silk worm!"

Thus the home trade of China is encouraged, and rendered efficient, whatever may become of the foreign. If the home trade is encouraged, consumption is supported; in which case it is evident, that the means of the artisan and operatives of all kinds, the most numerous class, enable them to obtain not only the necessaries of life, (agricultural production,) but also proper conveniences, (manufactured products.) If vital and healthy action be given to consumption to

this extent, it will encourage production to a degree such that foreign trade will be nearly a national luxury, or something not essential to existence. Should this take place amongst a people whose diversified climates and soils may be termed *omniferous*, capable of bearing all things, (like ours, a blessing we scarcely yet have learnt) it places their nation in the predicament of the independent individual, who spares a redundant article, merely because he does not want it; though on the other hand it is no inconvenience to keep it. Consequently he is indifferent, like the Chinese, either way; or, if he has a choice, he prefers that course which brings in specie instead of taking it out.

To be independent, as far as possible of foreign supplies; or, in other words, to have, of products, more to give than it is necessary to receive, except in hard cash, is a desideratum to nations: *the true Mexico.* And wherever practicable, (as with us, if we knew it,) will illustrate a sound and salutary principle in political economy. A nation that can have all her resources within herself, and adopts the policy to encourage home consumption to the utmost extent of her productive energies, proportioned to that consumption, lays the firmest foundation, so far as secular principles go, of her own permanent stability and independence.

ARABS, TARTARS, TURKS.

The introduction of the silk worms, and the consequent manufacture in Europe, produced a considerable impression on the demand for silks from China, which was increased by political changes then rapidly taking place in Asia. But notwithstanding the interruption of the caravans, and diminution of trade, in the sixth century, between China and Persia, in consequence of the establishment of the Turkish power, we have a proof, in what manner the Persians appreciated the value of what remains of their

Chinese intercourse was left to them, in the example of the Sogdian* ambassador, sent by the Turks to Chosroes king of Persia. He took with him many bales of silk for sale, and requested that the Sogdians, then subject to the Turks, might be allowed to supply the Persians with silk. Chosroes having bought the bales, immediately consumed them by fire, as the only answer to the request: an argument that needed neither mood nor figure in logic to prove to the ambassador that the king thought that a direct conveyance by the Persian Gulf would be more beneficial to his subjects than to give up the trade to foreign carriers.

The Arabs or Saracens, Tartars and Turks, all in their turns, participated, not in the producing, but in the carrying, of the silken fleece. On this account it is, as well because of their nomadic habits, that we see them not in the orchard or plantation, nor in any fixed position, but in the desert or at the caravan, as distant objects in the horizon that appear for a while and vanish. We therefore look for a new order of things, which we now find in

TURKEY AND PERSIA.

"Turkey supplies England," says Dr. Lardner, "with a considerable quantity of raw silk. Our imports from that country average more than 300,000 pound's weight annually. It is brought to us from Aleppo, Tripoli, Sayda, &c. but Smyrna is the principal port of commerce, especially for the silk of Persia, which forms a great part of that which is imported from Turkey. The silks of Persia are brought to Smyrna in caravans during part of the year, i. e. from January to September. The caravans dispatched in January are laden with the finest silk, and the quality is found to deteriorate with each following month.† The silk of Persia comes chiefly from the

* Ancient Sogdia was on the banks of the river Sogd, which now washes Samarcand.

† They produce silk in Persia by successive monthly crops.

provinces of Ghilan and Shirvan, and the city of Schamachia, situated near the edge of the Caspian sea. It is said that in some years no less than 30,000 bales of silk have been sent from these three places. The produce of Ghilan is the most abundant in quantity, and the best in quality. Shirvan and Erivan rank next; then Mazanderan, and lastly, Astrabad; but the latter is so inferior, as to be usually employed in forming fabrics intermixed with cotton. It is seldom or never exported. The silk from these different places is stored at Ardebil, another Persian city, whence caravans set out for Smyrna, Aleppo, Scanderoon, and Constantinople."

In Turkey, the production of silk is confined to cities or larger towns, in the neighbourhood of which, the mulberry is the chief object of cultivation, whose proprietors rear not the worm, but vend the leaves daily during crop season in the market in such quantities as purchasers require. At the commencement of the season, almost every family clears out all the rooms in the house except one in which they live. The worms being obtained, they purchase leaves, strew them over the floor, leaving a path all round next the walls, and placing the worms thereon, purchase for the next day or days the requisite quantity of leaves, and so on, paying no attention to the accumulation of litter, until the feeding season is over. This pile of stems, offal, leaves, and litter frequently rises to 3 or 4 feet; over which, when the worms seem inclined to mount, they place branches or brush wood for their accommodation, leaving them to find their way out of the labyrinth as well as they can. It doubtless would, in several cases, be profitable, here, as well as in Turkey, to proprietors of mulberry trees or orchards in the country, near cities or markets, to vend their leaves to persons residing in the town having apartments not convertible to a better purpose. To the former it would be a source of profit, and to the latter, especially to the infirm, of lucrative employment not obtained by other means.

But the Turkish senseless mode of feeding, is to be rejected altogether. The principal place for silk in all Asia Minor is Broosa, about 90 miles to the south of Constantinople.*

HINDOOSTAN.

We are not furnished with any evidence to establish the fact that the Hindoos, or the inhabitants of any part of peninsular India, were at an early period in possession of the mystery of producing silk, though we have reputable testimony to inform us of the existence of an ancient military class in Hindoostan, termed *Chinas*,† who migrated towards the country

* Broosa, sometimes called Brussa, or Bursa, and anciently Prusa, from Prusias one of its first kings, contains about 100,000 inhabitants. It is a beautiful city, and a place of considerable trade; four-fifths of its inhabitants are Osmanlis. It is situated at the foot of Olympus, a mountain of Bythinia, which covers it on three sides, and close upon which it lies. Its principal merchandise is silk, which constitutes the chief wealth of the place.

Broosa, with its environs, furnishes in the course of a favourable year, a crop of from 7000 to 8000 bales of all kinds of silk from the finest to the very coarsest. The manufactories, such as they are, are spread all over the city, but there is nothing that can be called a factory. The weaving is all done by job work, at so much a *peake* for a measure about three quarters of a yard; and these stuffs, so remarkable for beauty, are woven in miserable little rooms. only large enough to contain the loom and the weaver, or two, as the case requires.

When the figure is plain or striped, a man or boy alone, is sufficient for the purpose; but when flowered, it requires a man and a boy; one to weave and the other to work with bobbins in a manner to me incomprehensible, but which he could manage with his eyes shut as well as open. These beautiful silks are woven by miserable, half starved wretches, at a gain of not more than three, and sometimes only one, piastre (six cents) a day. But the abundance of the country is said to be such that the cravings of nature may be satisfied for a para, one-fortieth of a piastre, a day.

Broosa, like most of the places in Turkey, is surrounded by plantations of mulberry trees for the use of the silk worm; with the limbs of which asses laden may be seen every instant going to the city. These trees are planted in rows, not more than 2 or 3 feet apart, and are kept so low, that a man can reach the top limbs, which are all cut down every year as the worms require them.—*Extracted chiefly from the correspondence of Messrs. Rhind & Porter in the Silk Culturist.*

† See also the learned volumes of Dr. Vincent on the Commerce and

now occupied by the *Chinese*, who from their earliest existence seem to have been engaged in the successful development of both the raw and wrought material. The thousand collectors also that accompanied Alexander's expedition to the Indus, delegated to transmit specimens in Natural History to the Grecian philosopher, were, as well as the army, successful in sending to Aristotle, not only the worms, but also their product. This added to the additional circumstance quoted by Gibbon in the "Decline and Fall," that the Indians and Chinese had anciently constant commercial intercourse at Trincomalee, affords the presumption that amongst the ancient Hindoos there was not a *complete* ignorance, as to *theory* of the subject, but that the Chinese being more successful in the manipulation, both as to the raw and wrought material, were then, as they have continued to be since, in possession of the *practice*.

That the entire of both processes, the production and the manufacture, are, in India, now successfully in the hands of the moderns, the East India Company, is well known. Every thing, in short, must have invited it there; the soil, the climate of India, and above all the cheapness of labour. These not only originally gave the invitation, but subsequently completed the success. The island of Cossimbazar, in the province of Bengal, possesses every advantage suitable to the wants and labours of the silk worm. There have been a considerable increase in the quantity and improvement in the quality of the raw silk produced since 1760, in the territories of the East India Company.

Dr. Lardner says, "There are eight principal silk filatures or factories belonging to the company in Bengal. In every filature are employed, according to its size, from 3000 to 10,000 people; and if to these be added the mulberry planters, worm feeders, &c. the number dependent on each establishment may be stated at

Navigation of the Ancients, and Dr. Robertson's Historical Disquisitions concerning Ancient India.

from 10,000 to 40,000 men, women, and children. Attempts have been made to introduce the silk worm into other parts of the Company's possessions, especially on the coast of Coromandel." Dr. James Anderson introduced mulberry trees at Madras. In the year 1789 his success engaged several persons on different parts of the coast, Palamcotta, Masulipatam, Trichinopoly, and elsewhere, to the extent of 600 miles along the coast.

It does not appear that raw silk was produced in India, prior to the middle of the eighteenth century, with any view to immediate exportation. The little that then found its way to the English market, through a defect in the filature or from some other cause, was, in value, worth not more than from one-third to one-half of that of Italian silk. To obviate this, proper machinery and competent persons were sent for the establishment of filatures, or silk winding factories on the Italian system. After this we find improvement both in *quantity* and quality. In 1776, the shipments from Bengal amounted to 515,913 pounds, and during ten years, from 1776 to 1785, the average importation in England is quoted at 560,283 pounds. The amount continued to advance progressively. About 10 years since the average annual import of Bengal silks was 1,500,000 pounds.

In point of *quality*, prior to 1794 Bengal silk was thought applicable only to a very limited number of uses, and accumulation in the warehouses of the East India Company was the consequence. Their committee, therefore, advised that a portion of their stock should be converted into organzine by the silk throwsters of the country. The experiment tended to lessen the prejudice against Bengal silk, and render the trade less dependent on Italy, whence the greatest part of the organzine was brought. From that time the importations of Bengal silk have been progressively improving in quality, and the organzine made from it has grown into favour, until it now ranks nearly at par with Italian organzine. *In France, Italy, and*

*Turkey, there is but one regular annual crop, while in Bengal there are three, at intervals of four months; in March, July, and November.**

EGYPT.†

Neither is it to the land of Pyramids that we look so much for the vestiges of the early culture of silk, as for those architectural remains compared with whose dimensions the proud monuments of ancient Greece and Rome are insignificant. But Egypt is rapidly rising as to the arts and products of useful industry; and the people of the fertile valley of the Nile, that on a sudden emergency can command the labour of 250,000 men to cut a canal‡ of 48 miles in 6 weeks, can now produce six million pounds of

* "Bengal raw silk is distinguished by two appellations—country wound, and filature; the former being furnished by native adventurers, who can employ none but the rudest methods for winding it; while the latter is produced by servants of the East India Company, and treated according to the most approved European methods.

"Different degrees of fineness or coarseness are denoted in the Company's filatures in Bengal by the letters A, B, C; silk of 4 to 5 cocoons is called A No. 1; of 6 to 8 cocoons B No. 2; of 12 to 14, and 16 to 18 cocoons B No. 3; of 18 to 20 cocoons C No. 1; of 20 to 22 cocoons C No. 2; of 22 to 24 cocoons C No. 3. The silk which the natives reel by hand is much inferior, and is marked by the letters A, B, C, D, E. It must, therefore, be understood that the A No. 1 silk of one district in India will differ very materially in quality from that of another district, though bearing the same distinctive letter and number. Even the filature wound silks of different districts are subject to the same difference of quality. Thus, Bauleah filature is inferior to Radnagore or Cossimbazar filature, which again are excelled by the produce of Gonatea and Comercolly. In the last mentioned of these filatures, through the scientific skill and energy of the East India Company's resident, a system has lately been adopted of giving the necessary degree of heat to the cocoons while being wound, by means of steam; and both the arrangement and execution of the plans for this purpose speak very favourably for the talents of the parties employed, when the remoteness of the situation, and the consequent difficulties and obstacles to be surmounted are taken into account."—Dr. Lardner.

† E-*Gopt* the land of the *Copt*.

‡ The canal of Nahmoudieh, opened in 1819, connecting Alexandria with the Nile at Fouah, 48 miles long, 90 feet broad, and 18 feet deep.

*cotton** annually; and in addition to the successful culture of the *vine*, the *olive*, and the *sugar cane*, have now turned their attention to that of *silk*. Mr. Russel informs us, in his interesting volume on Ancient and Modern Egypt, that "In the valley of Tumulaut, *the ancient land of Goshen*,† is established a colony of five hundred Syrians for the purpose of cultivating the mulberry and rearing silk worms; while in the beautiful province of Fayoum,‡ the vine and the olive are again approaching that perfection which they once enjoyed, and for which the genial climate of Egypt appears so well calculated."

Nothing can so strikingly illustrate the wonderous effects, almost miraculously so, that may be accomplished by a good government, even in one generation!—ought we not rather to say, *by a government*§ *that Providence deigns to bless?* Egypt was lately a desert: feuds, distractions, and civil wars, worse than locusts, bats, and simooms, desolated the country; but such is the inflexible decision to suppress the evil, and prompt energy to encourage industry, of the

* "M. Jumel discovered one day," as we are informed by Mr. Russel, "in the garden of a Turk called Mako, a plant of the cotton tree, which he afterwards propagated with so much skill and success, as to have changed the commerce and statistics of Egypt. Jumel erected at Boulak, a superb establishment, equal in its structure to the finest European manufactory for spinning, weaving, dying, and printing of cotton goods. The latest improvements in machinery were borrowed from Europe; steam is the principal moving power, and gas is employed for the purposes of artificial light. At Siout Mr. Webster found a cotton manufactory in full operation. It gave employment to 800 men and boys who earn 10, 15, 20, or 30 paras and sometimes three piastres. Cotton factories are by no means uncommon in Egypt."

Mr. Russel says, "It is very probable the quantity of cotton which may be raised in Egypt will at no distant period equal the whole importation from America!" It is time then that we should be looking after silk.

† Between the Nile and Suez at the head of the Red Sea, and east of the ancient Memphis, Pharaoh's city, which was 10 miles south of the site of the present Cairo.

‡ About 40 miles south of Cairo, on the west of the Nile.

§ We could wish that this should be fully understood by the governments of the present day, who seem to think that no politics should be put off so late, as those of Him that made them.

Pasha,* whose portrait is now before us,† that Egypt, the late desert, is a garden that blossoms as the rose; and her agriculture, her commerce, her caravans, her ships, are growing, moving to the south, north, east, and west. Like her river, her redundance is overflowing, and Africa, Europe, and Asia are partaking the benefit. The Pasha can now not only supply wax, hides, coffee, myrrh, frankincense, coculus indicus, asafœtida, ivory, rhinoceros horn, tortoise shell, sal ammoniac, senna, tamarinds, ostrich feathers, balsam of Mecca, gum arabic, gum copal, benzoïn, aloes, coloquintida, gum ammoniac, galbanum, opoponax, spikenard, musk, gold dust, *grain*, but also *cotton* and *silk* to those who either *cannot* or *will not* raise them for themselves.

CHAPTER IV.

EUROPE.

SECTION I.

Naples, Calabria, Sicily; Italy, Venice, and Genoa.

No satisfactory reason, as yet has been assigned to account for a tardiness in the dissemination of the knowledge of silk culture, such that it was confined, after its first introduction into Europe, to Greece until the demolition of the Greek empire, or for 600 years. And mankind first became indebted for the further extension of that knowledge to means, on common principles not apparently justifiable. For

* This trait is here considered abstractedly from his former character.

† Russel's View of Ancient and Modern Egypt, chapter viii. In reading the volume through, there will be instruction and entertainment without disappointment.

Roger, the Norman king of Sicily,* invaded the Grecian countries, A. D. 1146, carried off the treasures of Athens, Thebes, and Corinth, led into captivity a number of silk weavers, and thus severing them from the natural ties of country and relationship, constrained them to settle at *Palermo* and *Calabria*, both then within the kingdom of *Naples* possessed by the Norman family, to conduct the cocoonery, filature, and manufacturing processes about to be established, by rapine and compulsion, in the dominions of Sicily. In twenty years, considerable excellency was attained under the instruction of the Greeks; and silks of diversified colours, some interwoven with gold, others adorned with figures or embellished with pearls were produced: but the dying in high colours, is said to be a later discovery.

From that time to the present the policy of that country has encouraged the manufacture, and it is esteemed there, in importance, as an agricultural product next to corn. A company invested with privileges for erecting manufactories of silks, stuffs, and camblets was established in 1752 by the king of Naples. The annual average of silks exported from Sicily is quoted at the value of $1,087,500. There are 900 looms at Palermo, 1200 at Messina, and a greater number at Catania. Of what is exported, the greater part is to the Levant, and but little to the English market. It is defective in reeling, dying, and sorting: the length of its skein also differing from the general importations, is inconvenient to the throwster, and the quality of its filament is not suitable to the general purposes of the manufacturer.†

ITALY, VENICE, AND GENOA.

The provinces of the Greek empire, which were

* After his return from the Second Crusade.

† Finizio, the celebrated manufacturer at Naples, makes and sends to the New York market, at the rate of 3000 lbs. of sewing silk a week. —Silk Cul., vol. i. p. 133.

the principal seats for the production of silk, coming, in the year 1203, into the possession of the Venetians; and Galata into that of the Genoese, lead to the presumption that they would not fail, under such favourable circumstances, to transfer to their equally congenial climates the means for the prosecution of a concern so lucrative as that of silk. There are few or no authentic records relative to the introduction of silk into any other part of Italy before the year 1300. At Venice encouragement was given by the government and the wealthy. The production, therefore, and the manufacture of silk were considered to be *noble* employments, the pursuit of which implied no degradation of rank. In 1300, Florence was the principal place for the manufacture, which at that time employed many thousand people. In the year 1306, the rearing of silk worms had become of so much importance at Modena, as to yield a revenue to the state, and its silk was then esteemed to be the best in Lombardy. But until the beginning of the sixteenth century, Bologna was the only city of Italy in possession of throwsting mills or machinery requisite for preparing the silken fabrics for weaving.

The average amount of silk annually exported from Italy is computed to exceed $17,500,000. Count Dandolo says that two-thirds, in amount, of all the exports from Italy are silks.*

* "Though there are silk factories in Italy, yet the greater part of fabrics are domestic manufacture, managed much in the same way as cotton was in this country before the introduction of power looms. The manufacturer purchases the silk of the grower, reeled suitable for such fabrics as he wishes to make, prepares it for the loom by dying, warping, &c., and then puts it out to the weaver, who weaves it in a hand loom and returns it. Afterwards it is finished and put up for market." —Silk Cul., vol. i. p. 13.

It may be well here to observe, that the power loom is nowhere used in Europe in the manufacture of silk. The first silk ever wrought by power loom was recently made in Rhode Island by Mr. Gay. But the quantity made has been small—enough, however, to assure us that when the material can be supplied in the necessary quantity, this method of manufacturing that article will be adopted.

SPAIN, PORTUGAL, AND THE NETHERLANDS.

It is well known that during the middle ages, literature and the arts were almost universally neglected. Such barbarian influence had invaded civilized nations, and so great a cloud had covered the earth, that for ages we find the Arabs chiefly signalized for a knowledge of what remained of art or science, and for attention to agriculture, manufacture, and commerce. For an acquaintance with these, it was to the Arabs or Saracens, their conquerors, that Spain and Portugal were indebted. Bishop Otto de Freysingen speaking of the great progress which silk manufactures had made in Spain, relates that, "after the siege of Milan, Frederick I., held a diet of the empire in 1158, in the fields of Roncaglia, at which were present, in magnificent attires, the ambassadors of the Genoese, who recently had conquered from the Saracens, two important cities, Lisbon and Almeria, both famous on account of their *manufactures* of silk."

It appears from a work that Marino Sanuto, a noble Venetian, commenced in the year 1306, and presented to the pope in 1321, entitled, "the Secrets of the Faithful," complaining of certain exactions imposed, during the whole of that time, on the European trader, in ports subject to Mohammedan princes, particularly as to *silk* and sugar, that *Apulia*, *Romania*, *Sicily*, *Crete*, and *Cyprus* were then signalized for the production of the former. In addition to which we find mention made of *Lisbon*, *Almeria*, *Granada*, *Murcia*, *Cordova*, and *Majorca*, as places engaged in the culture very early after the introduction of silk worms into Sicily. We are also informed that "when Ferdinand V. conquered Granada, A. D. 1492, and put an end to the Moorish power in Spain, he found there numerous establishments for the production of silk fabrics, which were rivalled by others in Murcia and Cordova."

This evidently implies that the Saracens were they, who were then principally employed in this culture. Although the first body of these primeval wanderers that entered Spain, crossed the straits from Mauritania, A. D. 712; yet we find that others inhabited *Sicily* from A. D. 828 until they were finally driven from thence A. D. 1272. And it was there, doubtless, that the Saracens first acquired the necessary knowledge as to the rearing of silk worms. On their expulsion from Sicily, a transit to Majorca and Spain would be easy; to which a knowledge of the successful establishments there of other tribes from the same progenitor, and of the same faith, would be an additional inducement.

Though since the above period, Spain has not been as eminent as other nations, either as a silk growing or manufacturing country, yet an attention as steady, though comparatively stationary, has been devoted to these concerns, as that want of both agricultural and commercial enterprise, for which, through political, not physical circumstances, that nation is characterized, would, perhaps, allow. Therefore, under this comparative dearth of interest, as to the culture in Spain, we shall pass to countries whence we may derive more information, contenting ourselves with observing, "en passant," that it was to Spain, that Henry II. was indebted for the silk stockings he wore, and which in his day attracted such extraordinary notice. Henry VIII., as well as Edward VI., were likewise supplied from that country with the same article for their personal use. We also learn, that not long after the commencement of the eighteenth century, when France, over and above her own production, imported yearly 4800 bales (each weighing 160 lbs.) of silk; of these 300 bales were annually imported of Spanish manufacture.

Though Spain and the Netherlands were subject to one crown in the person of Charles V., yet it was to France first, though to Spain subsequently, that the Netherlands were indebted for their knowledge

of the mysteries of the silken fabric. On the subject of the *trade* at Antwerp, in the middle of the sixteenth century, Guicciardini has given us the following testimony. "The merchants of Antwerp exchanged at Bologna their own serges and other stuffs, tapestries, linens, merceries, &c. for wrought silks, cloth of gold, silver crapes, &c. To Venice, they sent jewels, pearls, and the cloth and wool of England, and received in return, the finest and richest wrought silks, &c. Naples took from them cloths of their own and English manufacture, and returned raw, thrown, and wrought silks. Sicily obtained from them serges and cloth, paying in cotton and silk. The consignments to Milan were pepper, sugar, &c.; the returns were wrought silks. To Florence and Genoa, woollen stuffs and English wool; and the imports from the first of these places were very fine wrought silk, and from Genoa, satins and velvets."

History, by a thousand examples, everywhere testifies that the industrious energies of man will advance in the uninterrupted career of prosperity, only in climes blessed with peace and freedom from internal war and political distraction. Flanders ere this had ranked high as one of those favourable regions where commerce has fixed her seat, had not the desolating pest of war blasted the growth of ages, and driven whatever was likely to benefit man to more peaceful shores, the three days indiscriminate plunder and destruction to which Antwerp was subject in 1585, by the duke of Parma, then governor of the Spanish Netherlands, was a blow to the commerce of the Low Countries, from which they have never since recovered. The artisans, merchants, manufacturers, and their capital were dispersed; England became the asylum, and reaped in return the wealth that war forbade to dwell elsewhere.

As to the *production* of silk in the Netherlands, it remains only to quote M. d'Homergue. "The king of the Netherlands," to secure the instruction of a competent superintendent, "invited from Spain the

chevalier Barramendy, and assigned to him the castle of Manoge, in the vicinity of the town of Ath, ten leagues from Brussels, with a number of acres of ground belonging to it; which he has planted with the white mulberry. The king supplied him with considerable sums of money. The silk which was made, proved, however, of a very inferior quality. Nevertheless, the minister of the interior, Van Gobhelschroy, and the inspector of the national manufactories, M. Nettscher, continue to encourage the undertaking. The prince of Orange himself went in person to Manoge, to inspect the establishment, and gave it the sanction of his patronage."

FRANCE.

M. Mavet, in his history of the silk trade, asserts that *the first* mulberry tree* in France, was brought during the time of the crusades by Guipape of St. Aubon, and planted three leagues from Montmeliart. At an early period the Greeks supplied France and Germany with the fabrics, and silk came into use as an article for apparel. "Charlemagne wore above his linen doublet and under garment, a silk scarf round his waist. Not sooner than the middle ages did the sumptuous silk cloaks, embroidered with gold and silver, worn by the knights over their more martial equipment, come into fashion. Charles VI. wore constantly a black velvet coat of arms even in the hottest days. And Charles VII. wore at his entrance into Rouen, in 1449, a beaver lined with velvet, which was the most costly and elegant head ornament known at that time."†

* "This identical tree, it is said, was living in 1810, when the owner of the premises, M. de la Tour des pay le Chaux, caused this venerable parent of French mulberry to be preserved and respected, by having a wall built round it, and forbidding its leaves to be gathered. The cuttings and descendants of this tree now cover the soil of France, and produced to the state in 1810, a revenue of more than 100,000,000 pounds of raw silk, and more than 400,000,000 of francs in industry only, an amount greatly increased since that time."

† Count de Hazzi.

The *manufacture of silk* does not appear to have been introduced into France earlier than the time of Louis XI., who in 1480 established, with extensive privileges, at Tours, the artisans he had obtained from Genoa, Venice, and Florence. Authors do not appear to be perfectly agreed relative to the first introduction of the *silk worm* into France. Some refer that event to the year 1494, or during the campaigns of Charles VIII., when, it is affirmed that not only silk worms, but also a further supply of mulberry trees were brought from Italy, which gave prosperity to the rich countries that border on the Rhone. The progress of the manufacture, however, appears to have been comparatively stationary, until the reign of Francis I. The artisans obtained in the year 1521 from the dutchy of Milan, then in the possession of the French, introduced the manufacture into Lyons, and were encouraged by the patronage of that monarch. According to these authorities, it was from this time that a more rapid progress ensued, and manufactories sprung up not only in Lyons, but also in the southern provinces, adequate first to supply domestic consumption, and soon after to export wrought silks of a quality to sustain competition in foreign markets, which to France ultimately became, even from England only, a source of abundant wealth.

But according to Thuanus, it is to Francis I. that the French were indebted for the first introduction of the silk worms; which were successfully reared in Provence, Avignon, and Lyons. Others refer this event to the time of Henry IV. The more probable case is that all previous attempts, whether in the raising of silk, or in the manufacture of fabrics, compared with those resulting from the more liberal patronage of the monarch last mentioned, were not so extensively successful. Indeed it is acknowledged that both mulberry trees and silk worms were reared before in Lyonnois, Dauphiné, Provence, and Languedoc; but by Henry, it appears, they were naturalized as far north as Orleans; who also, according

to Mezeray planted the trees at Paris, and reared the worms at the Tuileries. The Parisians were encouraged by letters patent, conferring, on certain conditions, even titles of nobility, to introduce manufactories into the metropolis. But later experience has shown that the climate north of the Loire is not suitable to the insect.

M. d'Homergue informs us that Henry "invited one Michaeli from Italy into his dominions, and gave him, for the purpose of forming an extensive plantation of mulberry trees, and raising the article of silk, the castle of the old Marquis de Fournes, situate on the river Gardon, in the vicinity of Nimes. This ingenious foreigner was the first who began the manufactories of silk stuffs that now enrich that city. And tradition informs us that the king expended on those establishments the immense sum of near one million and a half of livres; an enormous sum in those days."

Olivier de Serres was highly instrumental in urging the king in the furtherance of this national benefit,* who is, indeed, called by the French to this day, the patriarch of agriculture. The king conscious of the merits of Olivier, "offered him the highest honours,—but he asked for one favour only, viz. that all useless trees might be banished from the royal gardens; an example that was soon extensively followed throughout the kingdom. At Olivier's recommendation 14,000 mulberry trees, and a large quantity of seed of the same tree were ordered from Italy, to supply the vacancies intentionally made in the Royal Gardens. In later times he also procured silk worms' eggs, and persons acquainted with their rearing. The trees, the eggs, and printed instructions, were distributed *gratis to agriculturists.*"† *Well, therefore, may Henry and Olivier be called the chief patrons of the silk culture in France.* Olivier for this, was entitled to greater merit, since he was op-

* Opposed at first, through misapprehension, even by Sully. This is curiously stated by Comte de Hazzi, q. v. p. 16, 17, 18.

† Comte de Hazzi.

posed (Anno 1603) by the powerful influence of Sully and the other ministers of the French king.* "How much would Sully now," adds Count de Hazzi, "be astonished, could he behold the evidence of his mistake, and the foresight of his royal master. Instead of continuing to pay to foreign merchants four millions of francs annually, for silk, the French draw many millions from their ancient suppliers, and enrich themselves in proportion."

The prosperity of the silk culture and manufacture in France, resulting from the favouring auspices of Henry IV. and Olivier de Serres, received a further impulse from the fostering care and patronage of Louis XIV. and his minister Colbert. A reward of three livres to the cultivator for every mulberry tree that should be found in a thriving condition three years after being planted, had the desired effect, and Provence, Languedoc, Dauphiné, Vivarais, Lyonnois, Gascony, and Saaitonge were speedily covered with trees though the former chiefly produced the silk.

Francis I., in the year 1540, granted to the city of Lyons, which may be termed the silk emporium of France, the privilege, since by various royal ordinances continued to 1717, of being the depot, through which, on account of certain duties, all silks brought by sea or land, had to pass. On an average, 6000 bales of silk, from the Levant, 1000 from Sicily, 1500 from Italy, 300 from Spain, and 1200 from Languedoc, Provence, and Dauphiné annually passed through the city, in which when in its most flourishing state 18,000 looms were in operation.†

* Memoirs de Max. de Béthune, Duc de Sully; Londres, 1767, vol. v. p. 74. And Count von Hazzi, p. 17 et seq.

† In 1656, frames for weaving silk stockings were obtained from England and introduced into Paris. In 16 years after, so rapidly had this branch of operative industry extended, that the silk stocking weavers were considered to be of sufficient importance to be incorporated by royal ordinance, and extensive stocking manufactories were established in numerous towns. This department of manufacture flourished until restrictions imposed by the injudicious interference of government repressed its prosperity, and it is now chiefly found at Cevennes.

Between 1688 and 1741, according to the "Commerce du 19me Siecle," France annually exported to England wrought silks to the value of 12,500,000 francs. For the protection of her own manufacture, prohibitory laws against the introduction of foreign silk commenced in England in 1765, which with various modifications have been, but not effectually, maintained until the present. The French export of wrought goods, notwithstanding, in 1784 is quoted at 25 million of francs, and in 1789, at 29,745,000 francs.

During a state of domestic peace, whatever were the foreign wars, the manufactures of France were in a prosperous condition. But two political events, the one characterized by religious intolerance and massacre, and the other by the prevalency of atheism and anarchy, proved by their destructive consequences, their origin. The desolating effects of the revocation of the edict of Nantes in 1685, in a few years reduced the 18,000 looms at Lyons to 4000; and consequences still more disastrous were exemplified at Tours; which before the revocation had 800 mills for winding and preparing silk, 8000 looms for weaving, and 40,000 persons engaged in the manufacture, as well as 3000 looms in the manufacture of ribands. Soon after the revocation, the mills were reduced to 70, the looms to 1200, and the operatives to 4000; and the consumption of silk which had amounted to 2400 bales decreased to 700!

The same features of family descent are indelibly stamped on the revolution. Before it, in 1786, Lyons had 15,000 looms; in 1789 not half that number, and in 1800, not more than 3500, nor more than 5800 artisans employed in the manufacture. The removal of that political sirocco allowed once more the healthy energies of man to circulate. In 1824 Lyons had 24,000 looms employed, and 36,000 artisans; and in 1825, a Lyons newspaper states that 8526 factories were in operation. Subsequent fluctuations, it is true, but neither material nor permanent, might be noticed,

but they chiefly arose from indiscreet interference and political impediment; from the artificial and not the natural springs of action.

The annual consumption of silks in France for 1823, was quoted at 1,600,000 lbs.* The difference existing, for nearly 30 years past, as to any statistics from customhouse documents, between *declared* and *real* values of exports and imports, precludes the possibility of quoting with accuracy from thence the quantity of silk sent to foreign markets. But from the most credible testimonies, we may state as an approximation to the truth, that in France, notwithstanding they raise so much silk, they annually import in value, on the average, to the extent of 30,000,000 francs of raw silk, or one-third of all they consume for their manufactures.†

Value of exported wrought silk.

Year 1801	39,314,000 francs.
Year 1820	123,063,000 francs.
Year 1821	111,689,000 francs.
Year 1822	99,063,000 francs.
Year 1835	124,850,000 francs.

One-third of which was brought to the United States!!!

OTHER STATES OF CONTINENTAL EUROPE.

Switzerland is one of the countries benefited by the ambitious projects and sanguinary discontent of other nations. The very weapon of Bonaparte, uplifted to destroy, in 1810, the commerce of England, merely

* "France produced in 1812, 987,000 lbs. of raw silk, and imported a like quantity."—Dr. Lardner.

† The statement from Count de Hazzi is as follows: "The annual profits from this single branch of industry in France, are estimated at 40 millions of florins; of which, a tenth is derived from the production of the raw material, and the remainder from the manufacture. According to the most recent statistical data, that kingdom derives from the production of silk 23,560,000 francs per annum, and 84,000.000 francs from the fabrication; and, consequently, the capital which is brought into circulation in both ways, amounts to 107,560,000 francs!!!

fell to crush the prosperity of his own people. The manufacturers of cottons and muslins inhabiting the vicinity of the lake of Zurich, losing their usual market by Napoleon's prohibition to admit, in order to exclude English manufacture, foreign goods into France, transferred their labours so skilfully to silk, that in a very few years, they became successful competitors with the French in the German markets. And the injury thus first inflicted by war on the internal resources of France, was redoubled by religious persecutions. On this account in 1815, 1816, and 1817, numerous artisans and manufacturers emigrated from Lyons, and transported their industry and capital to Zurich. Thus strangers and aliens profit by the domestic quarrels of others: but governments when they become Ahithophels learn not by such lessons.

The neighbourhood of Zurich, in 1814, contained not more than 2000 looms; in 1828 the looms had increased there to 10,000: and three of the factories employed 2600 and one 1204 artisans. In the year 1820, Germany entirely depended on France for a supply of wrought silks; since then silks of Swiss manufacture are so abundant in the markets of Frankfort and Leipzig, as to interfere materially with the French merchant. At Zurich and Basle silk fabrics of all kinds, crape and satin excepted, are now manufactured. The silk for umbrellas is also now made so extensively at Berne, as to supply the north of continental Europe. The encouragement given to Switzerland is such that other cantons are now enlisting in the enterprise: in short, what the litigious French have lost, the peaceful Swiss have gained.

Count de Hazzi says, "The history of the cultivation of silk in GERMANY divide sitself into three epochs; of which the two former may be called the unlucky! According to written documents, the first experiment on rearing the silk worm was made in 1598, at Rothenburg; and repeated at Wurtzburg, Hochheim, Dresden, and Stutgard." In 1669, further efforts were renewed, and a numerous company, consisting

of some of the most distinguished families in Munich, was organized. But the misunderstanding* with their Italian superintendant, Lucas Uffele, involved the company in law suits with him and the Italian merchants. The company sustained the loss of many thousand florins, and Lucas imprisonment, from which he did not escape till after a confinement of six years and a half.

The next impulse given to Germany, originated from the example of Prussia; to the history of which we refer under a distinct section. Hence, "from 1744 to 1755, 35,678 mulberry trees were planted in Saxony, which in 1753, produced 150 lbs. of silk. Similar success attended the endeavours which were made in Wurtemberg, Anspach, and Baireuth. But the most active promoter was the Elector Charles Theodore in the Palatinate, where, under his auspices, 80,000 mulberry trees were planted, and his example was soon followed in the dutchy of Deux-Ponts." A company was afterwards formed, by which extensive plantations of mulberry trees were made at Munich, Landshut, Engelkofen, Arnsdorf, Straubing, and Burkhausen; and the promenades, ramparts, and streets of many cities were ornamented with these trees; and the whole was in a promising state, until 1787. The cause of the *temporary* failure is a subject of distinct and subsequent consideration.

It is more remarkable than extraordinary that the third epoch of the silk culture in Germany, which is to be dated from 1821, was brought about by a lady. "During the distribution of premiums," says Comte de Hazzi, "at the agricultural solemnities of that year, in the circle of the Lower Danube, high praise was given to the exertions which had been made for the revival of the silk culture, by a noble lady, by name of Leeb Straubing. My own attention was thereby strangely kindled, and I remember that on my entrance into public life, as aulic counsellor, I

* Comte de Hazzi, p. 19, et seq.

heard much in the council of silk culture. I requested M. de Nagel* to draw up a memorandum respecting the mulberry tree—to enter into correspondence with the above mentioned lady, and to converse on the subject with the officers of the late superintendency. Much information was thereby obtained. With 50 silk worm eggs furnished by lady Leeb, the first experiment was made in the spring of 1822. Fortunately 3 mulberry trees were discovered not far from the capital. Within 44 days we were in possession of 50 beautiful cocoons, and the butterflies produced 2500 eggs. These were hatched in the spring of 1823, at which period more mulberry trees had been discovered. In 1823, the number of eggs of which we could dispose amounted to 600,000. Demands for eggs and directions for their use reached us from several parts of the kingdom. We were informed at the same time, how madly whole alleys of the precious trees had been cut down, even very recently, to serve for fuel like the commonest wood."

In the report, before the board for the extension of silk culture in Bavaria, we find that "mulberry trees had multiplied in all directions; that a great number had been found and fortunately saved from the axe, after *thousands of them had been felled through* SHEER IGNORANCE! *upwards of* 100,000 *had been cut down in one single district*, called the Regens Kreis; that the silk worms had withstood all the changes of climate, even when not tended at all; and that neither mortality nor diseases had occurred; that the silk produced was not inferior in quality to that of Italy." In 1825, the progress which the cultivation of silk was making in Bavaria, attracted the attention of several German states, viz. the kingdom of Wurtemberg, the Grand Dutchy of Baden, the Electorate of Hessen, Nassau, and Meinungen.

According to the report of Count Reigersberg, the

* Secretary of the committee of the Agricultural Society, and who had become acquainted with the culture of silk in Hungary.

quantity of silk produced in the Palatinate during the years specified below, may be stated as follows

In the year	1777	15,024 lbs.
——	1784	45,728 lbs.
——	1785	29,249 lbs.
——	1787	17,047 lbs.
——	1789	37,137 lbs.

In the same report we read, "According to long experience, the mulberry tree thrives among us as well as the common fruit trees. The experience of many years, proves sufficiently that the culture agrees at least as well with our climate, as with those of the provinces of France and Italy, which for several centuries have been considered as the principal seats of the silk culture in Europe. Whilst it failed so completely in those countries in 1816 and 1817, that the price of silk was more than double, the pound selling at 28 florins; we nevertheless obtained good crops. There remains not the least doubt that we can produce silk as cheap as in France. In the Cevennes, female spinners receive 42 kr. a day, and twiners 21 kr.; whilst, among us, women well acquainted with that kind of labour, will work for a third of the money. The silk produced in Germany is at least equal to that of Turin. Not long ago, in weaving silk imported from Italy and from Manheim, we found that the weaver, who had been accustomed to Italian and French silk, preferred by far the organzine of Manheim for its greater strength and equality."

It appears from the whole of the evidence before us, that there have been three distinct periods in the history of silk in Germany, commencing respectively in 1598, 1744, and 1821; that the two former were, as termed by Comte de Hazzi, unlucky, a consequence resulting from misunderstanding and mismanagement; the whole of which does not even yet appear to be removed; and therefore the enterprise commencing with 1821, compared with what it would be, were it free from impediments with which it has no physical or necessary connexion, is yet in its infancy.

On reading this singular statement given by Count de Hazzi, we were naturally led to inquire, what was the cause of the two former periods being "unlucky?" Was it the high latitude? Not so; since silk is produced not unsuccessfully, as far to the north as Sweden. Was it any peculiarity whatever of climate? We are informed not. It is by all parties confessed not only that mulberry trees and silk worms were raised there, but also that the German climate proved congenial to both. Was it because the production of domestic silk was unimportant in a national or financial point of view? Quite the contrary, since Bavaria alone, recently imported silks at the rate of 10 millions of florins per annum. Are we then to look, somewhat philosophically, into national character: the French, the Italians, nay even the Russians and the Swedes succeed, why not the Germans? We are met again by a negative, since the Germans, even the uneducated, are remarkable for their steady and industrious habits. Neither were the failures attributable to the want of the most encouraging examples from the neighbouring silk districts of France and Italy; in each, a source of abundant wealth to the nation, and giving employment to myriads of men, women, and children, otherwise, perhaps, destitute.

No such cause or causes can be assigned. Here then, in the history of men, either as individuals or formed into communities have we an anomaly! No impediment from any physical, natural cause whatever; not from the soil, situation nor climate; but from, if we are allowed the expression, a *political climate.* A moral phenomenon! Men destroy what Providence bestows! There are some cases, in which interference on the part of government with the industry and secular prosperity of its people, has been salutary, but many in which it has been a withering political atmosphere, something like a posthumous edition of Justinian's overreaching rapacity, that, by

grasping at too much, loses all.* Charity, however, intimates, that on the part of the German governments, it was philanthropy aiming at the people's weal.† Be it so;—yet the indiscretion that misdirected it, rendered the whole abortive.

But what a picture of artificial clogs and shackles have we on reading the long list of governmental restrictions, mulcts, charges, and compulsive measures. Surely the whole apparatus of screws, fetters, pincers, hammer, nail, and tongs, brought by the Spanish Armada, to show how the friends of the *holy* inquisition intended to *bless* the English with a *happy* purgatory in their own country, could not well equal such a thumb-screw system; such artificial manacles to clog the free blessings of the skies.

By some legislative fiat, monopolies rise, having officers, inspectors, and creatures enjoying unconditional salaries, and privileges that another, by the most untiring industry, loyalty, and merit, could never touch, though induced to engage, not by the reward that sweetens toil, but by coercive means. Two *castes* among the children of the same father! One has encouragement, the other compulsion, *though the merit is equal!* Here not only a full price, but even a bounty is given for the produce; there a law forcing to undersell at the risk of fine, bodily punishment, or imprisonment, for either not producing or withholding. The smiles of government beam with peculiar grace on the minions of the monopoly, but the back of the hand or the spurn of the heel is shown to its slaves. The former enjoy the gracious touch of

* "Αφεις το ιδιον," said the Grecian fabulist, "αρμησε το εκεινου λαβειν, απωλεσε δε αμφοτερα;" *dropping his own, he rushed to catch another's, and thus lost both.*

† Were this the case, why do favouritism and partiality appear in the development of facts, and two prices for a pound of cocoons. The one affording ample profit to the parasite; the other positive discouragement and despair to another, who was *forced* to sell by law and penalties at a different rate.

the sceptre, the latter have to kiss the dust at their master's feet.*

Men on the wrong side of the Eutopian walls felt this. They saw no prospect of adequate remuneration; aversion was the consequence, and the remedy they sought, was simply to let the worms die;—of the jaundice they said, but the true cause was, they gave them nothing to eat.† And thus having got rid of all the little soldiers quartered in their barracks, attention was next turned to the mulberry trees. To them they were not the monuments of interest, but the pyramids of oppression. In the fields they could not cheer them, but in the fire they could, and the choice was not difficult. At first, the trees seemed to walk away by night; soon whole lanes or alleys appeared through plantations; and finally entire forests were destroyed. Thus the district in Germany that could boast of its million mulberries, in a few years could scarcely furnish a score; and Germany by the mistaken policy of its rulers, became tributary again to foreign nations for silk. This extinction amounted to an almost national oblivion of the very existence of the thing by the wars of the French Revolution that soon after overran the states of Germany.

With the causes already assigned as productive of these disastrous consequences, there were others at different times combined, and some so singular or important in their character, as to demand a record on the page of history. At an early period, the people seem to have been set to work without competent instruction. Trees were planted in marshy, wet grounds, or in the streets, or along the road sides.

* See Treatise by Count de Hazzi, p. 42 and 43. It is said that "The Elector, Maximilian Joseph, who succeeded Charles Theodore, abrogated the compulsory system; and with it disappeared all the offences, complaints, and litigations, which it had occasioned."

† Σχολαστικις ειπε, μεγα ἐζημιωθην, κ. τ. λ. q. v. Hieroc. facet. "I have suffered a great loss," said he, "for when, through economy, I had taught my horse not to eat, just then he died!"

Hence the leaves became too much saturated with moisture, or too much loaded with dust to suit the purpose intended. Ignorance, in certain cases, was so complete, as to allow the hatching before the leaves were on the trees. Some, not aware of the large quantity required during the third and subsequent ages of the insect, had allowed the hatch without being sure of a quantity to supply the wants of the creature at those periods. Often the worms were not fed at the right time, and prodigious quantities were put together in close rooms, hence, as in crowded hospitals, unwholesome evaporation and diseases were the consequence. In numerous cases, government distributed portions of eggs to different regiments; but the soldiers cantooned the little animals on trees in the open air, till the first shower of artillery, rain, or hail, brought the young recruits to the ground, where they bivouacked, until such Goths, as ants, spiders, and sparrows destroyed them. Another adverse circumstance, but of a very different character, was, that at the prospect of the progress of silk culture in Germany the merchants and dealers in foreign silks took the alarm. They "persuaded the government that they would be ruined should it longer continue in existence; and that the state too, would soon discover and feel the disadvantages which it produces. They had calculated with a true mercantile spirit that where silk is produced, manufacturers would soon abound, whereby the price of the foreign commodity must fall, and could not be forced on the purchaser with large profits. They were listened to, and the institution was suddenly discontinued, under the pretence that the culture of silk could not be longer continued in Bavaria because it was injurious rather than profitable to the state."

It is not easy to consider silk as any thing less than one of the bounties of Providence to man; and considered in this light, it is the more remarkable, that the knowledge of no other art, or possession of any

other secular gift, is apparently more indebted to religious persecution for its diffusion, than is that of the culture of silk. By persecution, the Nestorians were exiled to the east, and it was the Nestorian monks that first brought the silk worms to Europe. It was the revocation of the edict of Nantes, or persecution, that supplied Spitalfields and other parts of England and Europe with silk weavers; the persecutions of 1815, 1816, and 1817 sent them to Zurich; and now we find that to the same cause PRUSSIA is indebted for her knowledge of the same art.

"Frederick the Great," according to Count de Hazzi, "having chanced to see a silk manufactory at Torgau, during his military operations in Saxony, and having had his attention called to the descendants of some French manufacturers, who had emigrated from their country, in consequence of the revocation of the edict of Nantes, and had established themselves at Berlin, gave the first impulse to the regeneration of the silk culture in Germany. He ordered plantations of mulberry trees to be multiplied, extensive buildings to be erected, printed instructions on the rearing of the silk worm to be distributed; and he promised considerable bounties to those who would devote themselves to that industry. According to a detailed account, the quantity of silk collected in the provinces of Magdeburg, Halberstadt, Brandenburgh, and Pomerania, amounted to 6849 pounds."

Mayet relates, that "In the year 1790, the Baron de Heintz, the Prussian minister, cultivated the mulberry and produced silk on his estate equal to the finest product of the Milanese." Difficulties, however, arising from similar mistakes, attended the early culture of silk in Prussia, as well as in the rest of Germany. "The ill success was in no way ascribed to the climate, but solely to the various blunders that were committed on its introduction; among which, we will only mention the compulsory measures which were employed, the little care with which the

trees were planted, and the eggs and worms themselves were treated."*

In 1825, however, successful exertions were renewed by M. Bolzani. He produced upwards of 1000 pounds of cocoons, or 100 pounds of silk, not inferior to the finest of upper Italy. From half an ounce of eggs, he obtains 41¾ pounds of cocoons, and his silk in Prussia was worth eight dollars a pound. He afterwards obtained from the neighbourhood of Lake Como, persons well acquainted with the reeling; and his silk was converted into organzine equal to the best of Italy. The fact, that 600,000 pounds of raw silk being yearly imported into Prussia, requiring the export of three millions of dollars, is sufficient to call the attention of that country to M. Bolzani's laudable undertaking.

In the year 1782, a fund was appropriated, in AUSTRIA, to encourage the introduction of the silk culture into Bohemia. The edicts of 1795 and 1804 declare, that "Since it is ascertained that the Italian silk is inferior to the Bohemian, and that the inexperience of cultivators, not the climate, had been the true cause of the small progress which the culture had as yet made, the agricultural corporations shall hereafter provide lands and buildings, and engage the inhabitants, by all the means in their power, in the pursuit of it." According to the Vienna Court Gazette of the 7th of September, 1825, it appears, that the cultivation of silk has since grown into favour; mistakes in the practice began to be exploded, compulsory measures to be abandoned, and rewards to successful cultivators, awarded. These attempts to promote the silk culture in the Austrian dominions are chiefly made in Tyrol, Lombardy, Illyria, Dalmatia, and a part of Hungary; and "That government strives to introduce it also in other provinces, with a view of saving the many millions

* Count de Hazzi, p. 40.

of florins which go abroad for stuffs of that material."*

As the subject refers to SWEDEN, it is sufficient to observe that Dr. Lardner quotes the Stockholm Journal for March, 1824, and Count de Hazzi the Stockholm Gazette for 1825. From the former we learn, that "The culture of the mulberry tree is extending itself in the provinces; and silk produced in Sweden has confirmed the remark formerly made on the superior fineness and solidity of silk grown in the north, compared with that from more temperate climes. It supports the ordinary preparation and dye equally with the best Italian, possesses the same brilliancy and the same softness:" from the latter, that "The business had again been taken up very earnestly, and that a great deal of excellent silk had been produced. The Swedish silk has sustained uninjured, the ordinary manufacture and dyeing, and obtained the brilliancy and softness of the East India product."

So indefatigable was the assiduity of Peter, justly called the *Great*,† in his endeavours to benefit his country, whose interest he viewed with parental care, that he forgot not the providential intention of the mulberry tree. To him, for the introduction of mulberry plantations, and to the Empress Catharine, for that of silk worms, RUSSIA is indebted; which have since been successfully cultivated and reared as high as the 54th degree of northern latitude.

* Count de Hazzi.

† Whilst on the pages of history we contemplate the character of a sovereign eminent for urging on his ambitious career, for fanning the flames of war, or, regardless of consequences, aiming at what he and his sycophants, by one of the most egregious perversions of language, call *glory!* we here and there select another eminent in being intent on the promotion, not more of his own, than of his people's interest and prosperity: a course infinitely more beneficent and amiable. Yet in indiscriminate language both are called great!! Alexander, was called great in the former sense, Peter of Russia in the latter. But which of the two deserved the epithet, it is not difficult to determine. There we see the human butcher of the million, here a source diffusing beneficence to his own and future generations.

A plantation of mulberry trees existed on Achtouba, an island formed by the division* of the Volga into two branches near the Caspian Sea. Here the empress placed a colony of 400 men, besides women, to whom she granted exemption from imposts for ten years; and received afterwards their capitation tax in silk at ten roubles per pound. Silk worms were reared successfully at Bauenhoff in Livonia, in the latter end of the last century. Manufacturing establishments are now regularly formed; fabrics and patterns of every kind easily imitated, and the Russians anticipate, if they have not already realized, the time when they shall become independent of Persia for the supply of silk.

Russia, though generally viewed as a northern country, includes climes, in Georgia, as low as the parallel of forty degrees, bordering on the ancient Armenia. But how Sweden that owns no territory south of fifty-five degrees, and that can scarcely grow bread stuffs sufficient for her own consumption, succeeds in rearing silk worms, whilst England, that extends to the parallel of fifty degrees, has abandoned the production of the raw material to more southern regions, is an inquiry that demands a more satisfactory solution than any yet attempted.

The introduction of silk fabrics into England has been traced back to a very early period. In the year 1180, during the reign of Henry II., the elegance of silks began to be an object of admiration. The time when silk was somewhat extensively *used* in that country, was, at least, as early as 1251. At the celebration of the marriage between Margaret, daughter of Henry III. and Alexander III. of Scotland, magnificence was displayed such, that 1000 English knights appeared richly arrayed in *cointises* of silk.† But

* From the town Tzaritzin, lat. 48° 35′, to Krasnoijar, lat. 46° 38′, or sixteen miles north of Astrachan.

† We are informed that the sail of the vessel that conveyed Henry V. (1415) on his invasion of France, which led to the victory of Agincourt, was of purple silk embroidered with the arms of England and France.

the earliest record of silk being *manufactured* in England, is the act of parliament passed in the year 1363.* Since this act is the first example, of which we find any mention, of the English restrictive policy, or protective system of its own artisans, at least relative to silks, and is so much opposed to the subsequent principles of Great Britain on the same point, we shall quote this and others more at large than we otherwise should, since they constitute an important subject for the consideration of nations. We find the whole, in reference to this point, more succinctly summed up in the Silk Culturist, than elsewhere.

"Whatever may be the true policy of the United States, with regard to freedom of trade, Great Britain has ever considered it, both her duty and interest, to protect her manufactures; and to this policy, and to the parliamentary encouragement it has received, the silk manufacture of England is indebted for its present extent and perfection.

"It would be tedious to give an analysis of all the acts of the British parliament which have been made to protect the silk manufacture of England, against continental competition, but an examination of a few will show the policy of the government. The first act for the encouragement and protection of silk manufacture is 37 Edw. III., c. 5 and 6. This statute was passed in 1363, and restricted manufacturers, merchants, &c. to the making and dealing in one particular kind of goods at their own election. An exception, however, was made in favour of females employed in the manufacture of silk. In 1454, the statute 33 Henry VI., c. 5, was passed, prohibiting, for five years, the importation of twined ribands, chains, or girdles," being the only articles then manufactured by the silk women of London. In 1463, the statute 3 Edward IV., c. 4, was passed, which extended the prohibition, during the king's pleasure, to several other articles, among which were laces,

* 37 Edw. III. c. 5 and 6.

ribands, and fringes of silk, silk twined, silk embroidered, tires of silk, purses and girdles. In 1482, the protection afforded by the provisions of this act was withdrawn by its repeal. The consequence was, the silk manufacturers were thrown out of employment, and reduced to extreme poverty and distress. They were, however, soon relieved by its being extended for the term of four years.

"Next followed the statute 19 Hen. VII., c. 21, which was passed in 1508, and prohibited the importation of any manner of silk wrought, either by itself, or with any other stuff, in ribands, laces, girdles, corses, and corses of tissues or points, upon pain of forfeiture. These being the only articles of silk then manufactured in England, it was by the same statute made lawful for all persons to import silk either raw or wrought into articles other than those enumerated. Towards the close of the reign of James I., a merchant of London (Mr. Burlamach) introduced a number of silk throwsters, dyers, and broad weavers from the Continent, and the fabrication of broad goods was commenced. In 1629 manufacturers of this description had increased to such a number as to entitle themselves to an act of incorporation, under the name of 'the master, wardens, assistants, and commonalty of silk throwsters.' From that period down to the present time, the silk manufacture of England has been under the constant watchfulness of parliament. Statutes have been made, repealed, and modified, as its interest or exigencies required, and the result has been that it has been carried to an extent and degree of perfection which astonishes the world." We here merely state these facts which are of a similar character, and refer to national policy; and we, at present, reserve our remarks to a future part of this subject.

So scarce an article do silk stockings seem to have been in the reign of Henry VIII., that it has been deemed worthy of record as an historic fact, that that monarch was compelled, for the occasion of gala days,

to obtain them from Spain; and that it was to Sir Thomas Gresham that his son, Edward VI., was indebted for a pair. Yet the tyrannical Mary, daughter of Henry VIII., seems to have dreaded that the time was coming, when blood, more common than aristocratical, would be covered with silk. Hence her sumptuary law of 1554 declares, that "Whoever, except magistrates and persons of higher condition, should wear silk in or upon his or her hat, bonnet or girdle, scabbard, hose, shoes, or spur leather, shall be imprisoned three months and forfeit ten pounds." This absurd statute was repealed in the first year of James I. Mrs. Montague, however, the queen's silk woman, in the year 1560, appears to have tested the affinity between royal legs and silk stockings, by a present of the latter, *not the former*, to Elizabeth, who was, on this occasion, so gratified, that she could never after condescend to wear the plebeian fabric of cloth hose.

Eight years after, the silk manufacture was so much improved as to be considered, by a series of legislative enactments continued to the present, an object of national importance. But notwithstanding all protective measures, a predilection for foreign fabrics prevailed to an extent such, that it was said, that every maid-servant became a standing revenue to the French king of one-half of her wages.

What the physical consequence of the experiment of silk stockings on queen's legs was on the inventive faculty in men's heads, we presume not to divine; yet no less strange than true was it, that it was precisely at this period, that there was, for the first time, introduced an "engine for knitting or weaving silk stockings," invented by the Rev. William Lea of St. John's College, Cambridge. Hence, soon arose the export of quantities of silk hose to Italy. And we also learn that the quality was such as to maintain its superiority abroad so long after, that in 1730, Keysler, who travelled in Italy, remarks, that it was common to hear the Neapolitan tradesman recom-

mending his hose, by saying, that "they were English." Mr. Lea, however, at that early period, found that he could weave more silk stockings than there were legs, except he went to France, to wear them; where he appears to have done well, until the assassination of the French king, Henry IV., his patron, left him in a state of destitution.

The success of the silk culture in France had a powerful influence on James I. of England. "Having seen," says he, "that in a few years, our brother, the French king, hath, since his coming to that crown, both began and brought to perfection the making of silk in his country, whereby he has won to himself honour, and to his subjects a marvellous increase of wealth,"—to which preamble he adds, "That from the experience of many private persons, who had bred silk worms for their pleasure, nothing had appeared to cause a doubt that they may be nourished and reared in England, provided there were a sufficient number of mulberry trees to supply them with food." To provide which James, by circular letters in 1608, recommends the planting of mulberry trees to the inhabitants of the different counties of England.

However strong the influence of royal recommendation may be, yet that of climate, opposed to it in this case, is said to have prevailed. According to documents existing in 1620, it appears that the people were willing, and the mulberry trees grew, as if by royal mandate, but neither the climate nor the silk worms were obedient subjects, and the king, therefore, turned his attention to the American colonies. The project, however, relative to the production of the raw material in England, was renewed in 1629, and in 1718; also in Ireland so late as in 1815, with a similar consequence. But since the white mulberry is said to have grown there, and to have put forth shoots in the first year, twenty inches in length, the silk worms to have been successfully reared for private amusement, the raw material to have been produced in the colder and more northern climate of Sweden,

and the humidity of that of Great Britain, to be capable of correction by a Dandoliere, or cocoonery on the plan of Count Dandolo, no reason completely satisfactory, especially since the discovery of the multicaulis, has been as yet assigned, for the want of success in the production of raw silk either in England or Ireland.

How far, or on what occasions, consistently with the welfare of the several trading communities of a nation, the "powers that be," whether invested in one or more individuals, can interfere with its commercial regulations, is, as already observed, an important inquiry; and it is the business of history, if not to decide, at least to produce facts to illustrate this question. In conformity with this view, the record of the events mentioned in the note subjoined, together with Dr. Lardner's remarks cannot be well omitted.*

* The progress made in the weaving of broad silks, "May be further collected from the terms of a proclamation issued in the year 1630, by Charles I., setting forth, that the trade in silk within the realm, by the importation thereof raw from foreign parts, and throwing, dyeing, and working the same into manufactures here at home, is much increased within a few years past. But a fraud in the dyeing thereof being lately discovered, by adding to the weight of silk in the dye, beyond a just proportion, by a false and deceitful mixture in the ingredient used in dyeing, whereby also the silk is weakened and corrupted, and the colour made worse; wherefore we strictly command, that no silk dyer do hereafter use any slip, alder-bark, filings of irons, or other deceitful matter in dyeing silk, either black or coloured; that no silk shall be dyed any other black but Spanish black, and not of the dye called London black, or light weight, *neither shall they dye any silk before the gum be fair boiled off* from the silk being raw." The same monarch, in the year 1638, issued directions removing in part, the prohibitions imposed by his former proclamation, and permitting such silk to *be dyed upon the gum, commonly called hard silk*, as was proper for making tufted taffetas, figured satins, fine silk ribands, and ferret ribands both black and coloured; and as his reason for this departure from his former directions stated, *with a degree of candour not always admitted into the edicts of princes*, that he had now become better informed upon the subject. This order further directed, that no stuffs made or mixed with silk should be imported, if of a less breadth than a full half yard, nail and half nail, on pain of forfeiture."

"It will be remarked that this misguided and unfortunate prince thus took upon himself to regulate, by the authority of proclamations, matters

Though in the preamble of the act passed in 1661, (13 and 14 Car. II., c. 15,) we are informed that the company of silk throwsters in London, then employed 40,000 men, women, and children; yet the existence of any such number engaged in the silk trade, at any one time in London, prior to the revocation of the edict of Nantes, is, perhaps, notwithstanding somewhat questionable.

It is an acknowledged fact on the pages of history, that no other event has contributed so much towards a general diffusion of knowledge in relation to the culture and manufacture of silk, as religious persecution. Those bigoted gentlemen of the monoculi genus, who would machine men to think precisely as they do, whether they can or not, or screw them down to it by the razor wheel, little dream how great a blessing their own act is conferring on others, whilst it is inflicting indelible infamy on themselves. Previous to the accession of Henry IV. to the throne of France, in 1594, the manufacture of silk was principally conducted by the Huguenots, a protestant sect in France. The Huguenots quietly submitted to the government of Henry, until he changed his religious principles, and allied himself to the dominant party, with whom the Huguenots were not unfrequently at open warfare. The defection of the king, who had been avowedly their protector, alarmed the Huguenots and threatened the tranquillity of his reign. In this

which had been previously ordered by acts of parliament. In many of these orders the king was guided by his own impulses, or influenced by the persuasions of others, rather than any sound or enlightened views of the nature of commerce; and he endeavoured to render the trade of his country subservient to his political designs. In another proclamation, issued by him for the reforming of abuses, which it was alleged had crept into practice in the manufacture and breadth of silks; the Weaver's Company were empowered to admit into their commonalty, a competent number of such persons, whether strangers or natives, as had exercised the trade of weaving for one year at least; provided the parties so admitted should be conformable to the laws of the realm, and to the constitution of the church of England; as though the fabrics which they wrought were susceptible of contamination, if touched by heretical hands!"

dilemma, two opposite interests to serve, a compromise of some kind was necessary. From motives of policy rather than principle, the heads of the party of Nantes were assembled, and the celebrated edict, which bears the name of that place, was passed granting to the Huguenots every thing necessary for their security; and for their satisfaction it was further declared that the edict should be irrevocable.

Notwithstanding this, this said *irrevocable* edict was *revoked* by Louis XIV. on the 23d of October, 1685. Thus while the worship of the Huguenots was suppressed, their churches demolished, and their ministers banished, the protestant laity were forbidden, under the most rigorous penalties to quit the kingdom. France, however, by this measure, lost more than half a million of her most industrious and useful subjects; an event that soon proved highly beneficial to other countries, which those who decreed that measure had not the skill to foresee. About 70,000 of these refugees made their way into England and Ireland; of which number, a large part, particularly those who were conversant with the fabrication of silks, settled at Spitalfields, and engaged in the manufacture of brocades, satins, black and coloured mantuas, black paduasoys, ducapes, watered tabbies, alamodes, lustrings, and black velvets, of the manufacture of which the English were previously ignorant. To the above mentioned intolerant and perfidious transaction, England is indebted for a knowledge of that manufacture for which she is now so celebrated. The silk trade, generally, was by this means improved. The English received the refugees with hospitality, and their industry was encouraged with a zeal that declared, according to the spirit of the times, that the wearing of silk, under those circumstances, was a proof of attachment to the protestant cause and of that charity which the protestant's gospel enjoins to be practised towards the unfortunate, whether friend or foe.

Previous to the settlement of the French refugees,

lustrings and alamode silks were imported; but the perfection to which those articles were soon brought, by the Spitalfield weavers, rendered further importation unnecessary. The persons engaged therein were, therefore, incorporated, and by two successive acts, (1392 and 1698,) protected against foreign competition. But neither the parliament nor the manufacturers had the prescience to guard against what rendered such protection nugatory. A change in the public taste directed the current of custom into a channel that caused the expenditure of the company's capital to be unproductive, except to serve as a lesson on the precarious tenure of objects, whose foundation is not necessity, but caprice and fashion.

France and England by the treaty of Utrecht in 1713, contemplated a sort of reciprocity, by which, on the payment of a trifling *ad valorem* duty, the manufacturers of each kingdom were to be admitted into the other. But no sooner do subjects of this nature become topics of national discussion than we see two judges in the court. The one pronounces the policy of such free trade or reciprocity to be liberal and enlightened, and the other affirms that it is injurious to the interests of domestic manufacture, and ruinous to the artisan. Great names are, and have long been, enlisted on each alternative of this dilemma; nations have been assembled and volumes expended on this discussion, but, "*adhuc sub judice lis est*," the question is yet unsettled, *except in minds possessed of only partial premises.* These generally have the temerity to decide; though it is well known that many advantages, equal or unequal, belong to each scale; and it is necessary to have *all* the weights in on each side, before we can perceive to which the correct balance inclines.

Had Dr. Lardner and others, who have written on the History of Silk, not discovered an inclination, from *ex parte* evidence, to come to a decision, we should have felt ourselves happily released from this subject, though of national importance. But occu-

pying at present, somewhat similar ground, it remains only to say, "sequor non passibus æquis," to supply, however, facts as yet furnished by none, leaving it rather to others, and to that further experience, which time alone can give, to pronounce the verdict not of one, but of nations, on this vital question in political economy, in which the silk as well as any other manufacture is involved.

By some the protective system is placed on a level with any monopoly that benefits the few, but oppresses the many; not knowing, however, that when the artisan is encouraged he is rendered a consumer as well as a producer to the full extent of his wages, and this supports domestic industry, of far greater consequence than any foreign trade whatever, that takes *specie* out instead of bringing it in. Others tell us, that when the productions of art are protected, the inventive faculty slumbers, and if foreign competition be removed, improvement ceases. This is specious: may pass off as a *flash note* amongst the many; but will not weigh against harder coin. Though the foreign merchant be not in the market, domestic competition exists; and the competitor at home naturally looks abroad for materials to give him a precedency which his neighbour cannot otherwise obtain. Besides, so restricted are many articles in their use, that all improvement beyond a certain point is a matter of mere secondary consequence, the creature more of fancy than service; and not of any importance to constitute an argument to oppose the welfare and comfort of the many thousands that compose an industrious community.

Neither has the American press been unemployed in lauding the late Mr. Huskisson to the skies, on the score of his opposition to the navigation act, his free trade and reciprocity bills; and, of course, for his pseudo services to the English manufacturers of silk. Had not the English silk weavers, cotton spinners, and operatives of all classes, had many enemies in the shape of *false* friends, why do they come over

here? By Huskisson's *enlightened patriotism* the ships of continental Europe became in possession of the carrying trade of Great Britain; they would receive only hard cash for their cargoes, without taking a single box or bale of English manufacture in return,* whilst thousands of British ships, involving millions of property, were rotting in the docks. The sufferings of myriads of silk weavers at Spitalfields, Macclesfield, and Dublin employed Michael Thomas Saddler,† and other powerful advocates against the sophistry of Huskisson, Fitzgerald, and Thompson, and other political neologists; but they were opposed by the fallacy that regards the extent of production without reference to the profit of the manufacturer, or benefit to the artisan. Huskisson's policy was *liberal* in *theory*, but *slavery* in *practice;* and so *enlightened* in the abstract, as to *deprive forever of education* the offspring of the labourer, who had to toil from eight to fourteen hours in the day to supply the deficiency of his parent's weekly earnings. Those that would compass heaven and earth to serve the foreign at the expense of the home trade, were loud in their acclamations against slavery amongst the *blacks*, without having any wish to remember that a larger volume of slavery, produced by their own measures, existed amongst the *whites* of a realm, whose shores were said to be such, that the slave at the moment of contact with them became instantly free!!

The year 1718 was rendered important in the history of silk in consequence of the unexampled assiduity of a youth to introduce in England, the throwsting mill. Relative to this subject we are furnished with the following interesting facts by Dr. Lardner.

* This, as may be attested by authentic documents, was, in many cases, literally the fact.

† The author of "Ireland, its Evils, and their Remedies;" also of an able work, involving a very singular theory, on "the Laws of the Increase and Decrease of Population." Few have given so many proofs, as it refers to the secular concerns of men, of their possession of sterling philanthropy as M. T. Saddler.

"Up to the year 1718, our machinery was so defective, that this country was, in a great degree, dependent on the throwsters of Italy for the supply of organzined silk; but at that time, Mr. John Lombe* of Derby,

* "There were three brothers, Thomas, Henry, and John; the first was one of the sheriffs of London, at the accession of George II., in 1727, on which occasion, he was knighted. About this time, the Italians had introduced great improvement in the art of throwing silk, and rendered it impossible for the Lombes, who were engaged in the silk throwing business in London, to bring their goods into the market upon any thing like terms of equality with the Italian. The younger brother was a lad at that time. By the laws of the Italians, it was made death, for any one to discover any thing connected with the silk manufacture: with this addition, the forfeiture of his goods, and his person and name to be painted outside of the prison walls, hanging to the gallows by one foot, with an inscription to remain as an indelible mark of infamy. Young Lombe, however, was not to be deterred. On his arrival, and before he became known, he went, accompanied by a friend, to see the silk works. No person was admitted except when the machinery was in action, and even then he was hurried through the rooms with the most jealous caution. The celerity of the machinery rendered it impossible for Mr. Lombe to comprehend all the dependencies, and first springs of so extensive and complicated a work. He went with different persons in various habits, as a gentleman, a priest, or a lady, and he was very generous with his money; but he could never find an opportunity of seeing the machinery put in motion, or of giving to it that careful attention which was his object. Despairing of obtaining adequate information from such cursory inspection, he bethought himself of associating with some clergyman; and being a man of letters, he succeeded in ingratiating himself with the priest who confessed the family to which the works belonged. He seems to have opened his plans, partly at least, to this person, and it is certain that he found means to obtain his co-operation. According to the scheme adopted, Mr. Lombe disguised himself as a poor youth in want of employment. The priest then introduced him to the directors of the work, and gave him a good character for honesty and diligence, and described him as inured to hardships. He accordingly engaged as filature boy, to superintend a spinning engine. His mean appearance procured him accommodation in the place which his design made the most acceptable to him. While others slept, he was awake, and diligently employed in his arduous and dangerous undertaking. He had possessed himself of a dark lantern, tinder box, wax candles, and a case of mathematical instruments. In the daytime, these were secreted in a hole under the stairs where he used to sleep. He then went on making drawings of every part of this grand and useful machinery; the priest often inquired after his boy, and through his agency, Lombe conveyed his drawings to Messrs. Glover and Unwins, at Leghorn, the correspondents of the Lombes, who made models from them, which were despatched piecemeal to England,

having in the disguise of a common workman, succeeded in taking accurate drawings of silk throwsting machinery in Piedmont, erected a stupendous mill for that purpose at Derby, and obtained a patent for the sole and exclusive property in the same, during the space of fourteen years. This grand machine was constructed with 26,586 wheels and 97,746 movements, which worked 73,726 yards of organzine silk thread with every revolution of the water wheel, and as this revolved three times in each minute, the almost inconceivable quantity of 318,504,960 yards of organzine could be produced daily! Only one water wheel was employed to give motion to the whole of this machinery, the contrivance of which was such that any one or more of the movements might be controlled or stopped, without obstructing the continued action of the rest. The building wherein this machinery was erected was of great extent, being five stories in height, and occupying one-eighth of a mile in length. So long a time was occupied in the construction of this machinery, and so vast was the outlay it occasioned, that the original duration of the patent proved insufficient for the adequate remuneration of its founder; who, on these grounds, applied to parliament, in the year 1731, for an extension of the term for which his privilege had been granted. This, however, in consideration of the great national im-

in bales of silk. After Lombe had completed his design, he remained at the mill until some English ship should be on the point of sailing for England. When this happened, he left the works and hastened on board. Meanwhile his absence had occasioned suspicion, and an Italian brig was despatched in pursuit, but the English vessel happily proved the better sailer of the two, and he escaped. It was said that the priest was put to the torture, but another states that after Mr. Lombe's return to England, an Italian priest was much in his company, and it is the opinion that this was the priest in question. The common account of Mr. Lombe's death is, that the Italians exasperated at the injury done their trade, sent over to England an artful woman, who associated with Mr. Lombe's Italian servants engaged in his works, and having gained over one, poison was administered, of which, it is said, Mr. Lombe died on the premises, on the 16th November, 1722, in the twenty-ninth year of his age."—*Roberts' Manual; Silk Grower, &c.*

portance of the object, which was opposed to its continued limitation in the hands of any individual, was not granted; but parliament voted the sum of £14,000 to Sir Thomas Lombe, as some consideration for the eminent services rendered by him to the nation, in discovering with so much personal risk and labour, and in bringing to perfection, at great expense, a work so beneficial to the kingdom. The grant being made upon the sole condition that competent persons should be allowed to execute an exact model of the machinery, to be deposited in such a place as his majesty should appoint, in order to diffuse and perpetuate the manufacture. The act authorizing the issue of the money mentions among other causes justifying the grant, "the obstruction offered to Sir T. Lombe's undertaking by the king of Sardinia, in prohibiting the exportation of the raw silk which the engines were intended to work."

The history of the silk manufacture in England after this, abounds with a multitude of acts of parliament, of local consequence, and therefore more suited to the English than to the American reader. They are standing evidence, however, of what importance this branch of national industry was estimated by the British legislature; and as documents they are valuable in affording a series of statistical testimony, of the constantly increasing magnitude and prosperity of this manufacture in the British Isles.

In the year 1783, the different branches of the silk manufacture amounted in value to £3,350,000. Soon after the year 1825, the number of throwsting mills in the country were registered at 266; of spindles at 1,180,000; and of the looms employed in Spitalfields alone at 17,000.

In the year 1821, we find the following instructive extracts from the minutes of evidence before both houses of parliament on the subject of the silk trade and manufacture.

"Silk is principally imported from Bengal, China,

Italy, and Turkey. The average of late years, amounts fully to 1,800,000 lbs. Bengal sends near 800,000 lbs.; China about 100,000 lbs.; Turkey the same. The remainder comes from Italy. The duties on raw silk are as follows; Bengal 4*s.*; Italian, Turkey, and China, 5*s.* 7½*d.* per pound. Italian organzine, 14*s.* 6*d.* to 14*s.* 7½*d.* per pound. Prices paid for organzine in England, 7*s.* to 10*s.* per pound. The waste is from three to fifteen per cent. No organzine is made in France; they prepare their own trams and singles. China silk is applicable to hosiery; the Italian is not."

"The price for making organzine in Italy is from 3*s.* to 4*s.* per pound. In England it costs from 7*s.* to 10*s.* per pound. The French are superior to the English in ribbons, but inferior in hosiery. China silk goods are heavier than English, but not of a better quality. The China raw silk is equal to most Italian, and better than any Bengal."

"In the Bengal silk there is a kind of cottony or fuzzy substance, which is thrown up into a pile or knap when woven. The price of Bengal silk per pound, duty included, is from 14*s.* to 30*s.*; that of Italian from 18*s.* to 35*s.*"

"Nearly 2,000,000 pounds of raw and thrown silks are annually imported into England. This gives employment to 40,000 hands in throwsting it for the weaver, and their wages are £350,000. Half a million pounds of soap, and a large proportion of the costly dye stuffs are consumed, at a farther expense of £300,000; and £265,000 more are paid to winders to prepare it. The number of looms may be taken at 40,000; and the weavers, warpers, mechanics, &c. to be 80,000, whose wages amount to £3,000,000. Including infants and dependents, 400,000 mouths will be fed by this manufacture; the amount of which may be estimated at £10,000,000."

"The price of dyeing at Lyons is 15 sous, or 7½*d.* per pound; and colours 24 sous, or 1*s.* In England

the price of the first is 2*s.*, and of the latter from 2*s.* 6*d.* to 4*s.* The drawback on silk goods in England is 12*s.* per pound, on ribands, 10*s.* The labour in preparing raw silk, affords much more employment to the country producing it, than any other raw material. The defect complained of in the Bengal silk, is in the preparation. There is nothing in the nature of the silk to render it inapplicable to every purpose of Italian silk."

In the year 1824, the high duty on the importation of raw silk was abandoned for one merely nominal; that on thrown silk was reduced nearly one-half; and the admission of foreign manufactured goods was rendered legal in 1826, under an *ad valorem* duty equivalent to about thirty per cent.*

* In regard to the silk manufacture, the duty required in order to maintain the English weavers in the same relative position which they already hold with those of France is much lower than might, without inquiry, be imagined. Independent of duties, the entire difference in the cost of one pound of the best thrown silk, when manufactured into sixteen yards of Gros de Naples, is 5*s.* 6*d.*, or barely fourteen and a half per cent., as appears by the following statement.

Comparative estimate of the cost of one pound of silk when manufactured into Gros de Naples at Lyons and London.

In Lyons.

	£	*s.*	*d.*
Price current of organzine 25*s.* per lb., 8 oz. of which	0	12	6
Ditto of tram 22*s.* 6*d.* per lb., 8 oz. of which	0	11	3
Dyeing, warp, and short	0	0	11
	1	4	8
Add 4 oz. for loss in dyeing and waste to make 16 oz. when manufactured	0	6	2
	1	10	10
	s.	*d.*	
Winding and warping	1	3	
Weaving 16 yards, at 4½*d.*	6	0	
		7	3
	1	18	1
Difference in favour of the French manufacturer	0	5	6
	2	3	7

For the information of the exporter, the scale of duties *at present* chargeable on the importation of raw, thrown, and manufactured silks, is furnished in the note below.*

In London.

	£	s.	d.
Price current of fine tram silk in Italy	1	2	6
Export duty and expenses	0	0	6½
Carriage to Calais	0	0	3½
	1	2	4
Eight oz. of which	0	11	2

	£	s.	d.
Price current of fine organzine in Piedmont	1	3	0
Duty and expenses	0	0	9¾
Carriage to Calais	0	0	3¼
	1	4	1

Eight oz. of which	0	12	0½
Dyeing, warp, and short	0	1	6
Four oz. for loss in dyeing and waste to make 16 oz. when manufactured	0	6	2

	s.	d.			
			1	10	10½
Winding and warping	2	0½			
Weaving 16 yards, reckoning 1 oz. to the yard, at 8*d.* per yard	10	8			
			0	12	8½
			2	3	7

* Knubs, or husks of silk, and waste of silk, the cwt., 1*s.* *Raw silk*, the lb., 1*d.* *Thrown silk, not dyed*, namely, singles, the lb., 1*s.* 6*d.* Tram, the lb., 2*s.* Organzine and crape silk, the lb., 3*s.* 6*d.* *Thrown silk, dyed*, namely, singles or tram, the lb., 3*s.* Organzine or crape silk, the lb., 5*s.* 2*d.* *Manufactures of silk, or of silk mixed with any other material*, namely, silk or satin, plain, the lb., 11*s.*, or, at the option of the officers of the customs, for every £100 of the value, £25. Silk or satin figured or brocaded, the lb., 15*s.*; or, at the option of the officers of the customs for every £100 of the value, £30. Gauze, plain, the lb., 17*s.* or 30 per cent. *ad valorem*. Gauze striped, figured, or brocaded, the lb., 27*s.* 6*d.*, or 30 per cent. *ad valorem*. Velvet, plain, the lb., 22*s.*, or 30 per cent. *ad valorem*. Velvet figured, the lb., 27*s.* 6*d.*, or 30 per cent. *ad valorem*. Ribands, embossed or figured with velvet, the lb., 17*s.*, or 30 per cent. *ad valorem*. And if mixed with gold, silver, or other metals, in addition to the above rates 10*s.* per lb. Fancy silk, net, or tricot, the lb., 24*s.* Plain silk lace, or net, the square yard, 1*s.* 4*d.*

We may judge of the immense quantity of raw and thrown silk annually imported into Great Britain, from the following quotations:

The importation was, in

	lbs.	lbs.
1819, of raw silk	1,480,990	
— thrown	301,588	
		1,782,578
1820, of raw silk	1,702,416	
— thrown	309,953	
		2,012,369
1821, of raw silk	1,940,516	
— thrown	350,209	
		2,290,725
1822, of raw silk	2,037,415	
— thrown	370,273	
		2,407,688
1823, of raw silk	2,085,972	
— thrown	346,314	
		2,432,286
1824, of raw silk	3,540,910	
— thrown	452,469	
		3,993,379
1825, of raw silk	3,030,756	
— thrown	556,642	
		3,587,398
1826, of raw silk	1,955,042	
— thrown	289,325	
		2,244,367
1827, of raw silk	3,755,242	
— thrown	454,015	
		4,209,257

Manufactures of silk, or of silk mixed with any other material, the produce of, and imported from places within the limits of, the East India Company's charter, for every £100 of the value, £20. Millinery of silk, or of which the greater part of the material is of silk, namely, turbans or caps, each 15*s*. Hats or bonnets, each 25*s*. Dresses, each 50*s*., or 40 per cent. *ad valorem*. *Manufactures of silk, or of silk and any other material, not particularly enumerated, or otherwise charged with duty*, for every £100 of the value, £30. *Articles of the manufacture of silk, or of silk and any other material, wholly or part made up*, not particularly enumerated, or otherwise charged with duty, 30 per cent. On the exportation of silk manufactured goods, government allows the following drawbacks. For every pound weight of manufactured goods, composed of silk only, 3*s*. 6*d*. Of silk and cotton mixed, one-half being silk, 1*s*. 2*d*. Of silk and worsted, one-half being silk, 7*d*. To prevent the introduction of contraband goods, the importation of foreign wrought silks is restricted to the ports of London, Dublin and Dover, and the privilege is confined to ships of not less than 70 tons burden.

The importation was, in

1828, of raw silk	4,162,550	
— thrown	385,262	
		4,547,812
1834, of raw silk		4,340,000
or of raw and waste silk		4,449,456

From this we learn that England is now importing, nearly at the rate of four millions and a half of raw silk annually, or a quantity in value nearly equal to $22,000,000: *the whole of which might be supplied by the wide growing silk climes of the United States.*

Of the quantity of raw silk imported, above quoted for the year 1834, it is said, that 1,235,104 lbs. were from France; 1,758,637 lbs. from the British East Indies; 562,834 lbs. from China; 419,368 lbs. from Turkey and Greece, and 403,214 lbs. from Italy.

But it is not the least interesting part of the story, that an American gentleman, recently travelling in England, was informed that of the raw silk imported into that country, 61,105 lbs. in 1834, and 27,236 lbs. in 1835, were *supplied by the United States.*

Of the 4,340,000 lbs. of raw silk imported in 1834,

The cost is stated at	$20,125,205
Cost of dyeing ditto	1,640,000
Of winding, weaving, and finishing	18,616,695
Interest on capital, wear, tear, &c	13,077,605
	$53,459,505

The amounts of the value of the manufacture, as to each species of fabric, for 1834, is quoted thus:

Broad silks	$18,815,000
Ribands	8,415,000
Handkerchiefs	2,400,250
Crapes	1,547,440
Silk hose and gloves	1,822,450
Sewing silks	1,248,000
Mixed goods	12,480,000
Miscellaneous	3,246,660
Sundries	1,892,125

These various manufactures give employment to

more than 208,000 people; of which there are engaged in

	Persons.
Broad silks	55,603
Ribands	27,765
Handkerchiefs	9,518
Silk hose and gloves	7,350
Sewing silk	1,970
Mixed goods	49,452
Miscellaneous	16,726
In other kinds	27,832

The *declared* value of British exports of manufactured silks in 1836, amounted to £917,822. Its *real* value probably £1,200,000 or $6,000,000. Of which, we learn, that the United States took about the value of $1,200,000. But the most singular fact is, that France, so recently as 1834, an *exporting* country of wrought silks to England, to a very considerable amount annually, is now of the same article importing from England, and in 1836, to the value of $317,000. This is attributed to the constantly advancing improvements in the manufacture made in Great Britain.

The whole, whether for home consumption or export, from all the evidence we have on the subject, appears to be on the rapid increase to that degree, that the value of silk fabrics produced in 1837–8, it is expected, will not fall short of $75,000,000.

Before we take our leave of the history of silk, so far as it respects what is commonly called the *old world*, and cross an ocean to contemplate the rising of a new, and probably soon a greater theatre for the growth of the mulberry, and the rearing of the little industry-stirring insect in the *new world*, where, perhaps, at no distant period hence, a scene of prosperous activity may unfold historic pages not even yet anticipated, that may vie in extent and celebrity with that of *silk Empire the First;* we may be allowed to take a transient visit here and there to regions where people of merely insular and narrower shores are setting noble examples to us who are in possession of one of the choicest parts of a vast continent, so

large that we ourselves scarcely know its length or breadth, and what is more, scarcely yet do we know the varied and interminable blessings of its many diversified soils and climates: "*O fortunatos nimium, bona si sua nôrint, Agricolas.*"*

If any place could appear not congenial to the culture of silk, we should have thought it to be the island of MALTA, generally a barren rock, that absolutely borrows *soil imported* from Sicily and elsewhere. Yet even here, the mulberry not only grows and the silk worm thrives, but the untiring enterprise of its inhabitants, determined not to be disappointed by its new competitor, Egypt, in the the cotton market, is bending its attention to silk with every promise of a favourable result. It is also said, that even on this *factitious* soil, the mulberry grows more rapidly than in Italy. What may not be expected, when even rocks, if invited, refuse not to be prolific? And what can the island of ST. HELENA be but a rock to have withstood the wash of the mighty Atlantic, ever since the days, perhaps, of Peleg; and here, also, we learn that mulberry trees are flourishing, and that success, commensurate with the insular limits of this solitary isle, are expected.

The ISLES OF FRANCE and BOURBON are more favoured, since the soil and climate are such as to produce Turkey corn and rice twice a year; and also bananas, oranges, citrons, and tamarinds; and in company with these, we shall now find the mystic transformation of the produce of a tree into the silken robe. The French originally attempted to introduce the culture here, but the colonies afterwards came into the possession of the English; and we learn that the governor of the Mauritius, Sir Robert Farquhar, procured, in the latter part of the year 1815, silk worm eggs from Bengal, and intrusted them to the care of M. Chazal. In March following, about 80,000 cocoons were obtained, and a fourth part reserved for

* O ye husbandmen, how extremely fortunate, if only ye knew your own privileges.—Virg.

reproduction on the following season. Notwithstanding this, and the distribution of silk worms to many of the colonists, M. Chazel alone, in 1817, produced 116 pounds of silk, or one bale, which was conveyed to England in the following year; when he claimed the premium offered by the Society for the Encouragement of Arts for the growth of silk in the British colonies. The most eminent silk brokers in London pronounced the silk to be of fair quality, and M. Chazal obtained the premium.

The Silk Culturist informs us that "The government of CUBA is making an effort to introduce the culture of silk in that island, with a fair prospect of success. Being situated between twenty and twenty-three and a half degrees of latitude, the mulberry will be constantly in foliage, and a regular succession of crops may be made during the whole year."

M. d'Homergue says, "I have been informed that Messrs. Chabaut and Latour of Nimes, were called to MEXICO some years ago (prior to 1829) to introduce the culture of silk. With the particulars of their success I am not acquainted, but it is generally understood at Nimes that they both died rich from this culture. I have since been informed, that they made beautiful sewing silk at Mexico, which has been acknowledged in France to be superior to any made in that country. The French manufacturers said they could easily make such silk, but that it would cost them too much. I presume the Mexicans employ their best material in that manufacture, because they have not yet learned to put it to a better use. I am informed also that raw silk has been exported from this country to Mexico, and sold there at a great profit, although it was very inferior to that of this country; even at eighteen dollars a pound."

Even the inhabitants of Lower Canada, as well as those of Sweden, contemplate the successful introduction amongst them of the silk culture. Matter of fact and history has taught them that the state of Vermont is suitable to the growth of the mulberry and the rear-

ing, at the proper season, of the silk worm; and, therefore, they infer, because the winters of Lower Canada are even milder than those of Vermont, that they will succeed amongst them. The Farmers' Advocate, published at Sherbrooke, informs us, that the white mulberry not only endures the climate, but grows luxuriantly in the southern and eastern townships. The Canadians are even so sanguine as to hope, that if due care be employed, the colonies of British America, may supply Great Britain with more of the raw material than she imports from any country, except those beyond the Cape of Good Hope.

NORTH AMERICA.

James the I. having had fourteen years, since his recommendation, in 1608, of the silk culture, to the several counties in England, to discover the impracticability, in consequence of the climate, of rearing silk worms there, turned his attention to North America; and in the year 1622, in order that his manufacturers at home might draw their supplies of the raw material from his colonies abroad, urged the Virginia Company to promote the cultivation of mulberry trees, and the breeding of silk worms. To the attainment of this object, James did not fail to send over silk worm eggs, white mulberry trees, and printed instructions.* He gave special instructions to the Earl of Southampton, to urge the cultivation of silk in the colonies in preference to tobacco, to which his majesty appears to have had an implacable aversion. The earl, therefore, wrote to the governor and council, desiring them to compel the colonists to plant mulberry trees, which met the concurrence of the colonial assembly in 1623. The act passed in 1656, describes the culture of silk as the most profit-

* Written by Mr. John Bonoeil, a member of the Virginia Company, who was so confident of the practicability of the plan, that he asserted that with a sufficient number of hands, as much silk might be raised in Virginia as to supply all Christendom.

able for the country, and a penalty of ten pounds of tobacco was to be imposed on every planter who should fail to plant ten mulberry trees on every 100 acres of land in his possession; but a premium of 4000 lbs. of tobacco was to be given as an inducement to remain in the country for the purpose of producing silk; and in the following year a premium of 10,000 lbs. of tobacco was to be awarded to the exporter of £200 worth of the raw material; and 3000 lbs. of tobacco to the producer of 1000 lbs. of wound silk in one year. After various amendments, this system of legislative rewards and penalties ceased in 1669. "While Sir William Berkely was in England, on the occasion of his reappointment as governor, in conversation with the king, his majesty strongly recommended the culture of silk, and as an inducement to the colonists to attend to his advice, mentioned, 'that he had worn some of the silk of Virginia, and found it to be not inferior to that raised in other countries.'"*

Though the reason why this first essay towards the culture of silk in Virginia was not successful has not been assigned, yet a sufficient one is given in the following extract from a scarce work, entitled "*the Trade and Navigation of Great Britain and Ireland, by Joshua Gee,*" published in 1760. "He" (James I.) "and his courtiers seemed to be very fond of the undertaking, and letters were written to Virginia to promote that manufacture. Some small progress was made there, and letters passed between the planters and gentlemen here; *but as soon as they thought that they had engaged the planters to begin upon it, instead of promoting it heartily, and sending some able and skilful persons to direct the undertaking, they threw all upon the planters,* and that noble design came to nothing; whereas that of France succeeded to the immense profit of that kingdom." Under these circumstances, not through any natural disabilities but

* Roberts' Manual.

from the want of proper connexions and facilities, it ceases to be a matter of wonder, that the planters found a source of more *immediate* profit in the growth of tobacco, for which they met with a ready market both in the mother country and in the north of Europe.*

In the early settlement of GEORGIA, in the year 1732, a piece of ground, belonging to government, was allotted as a nursery plantation for white mulberry trees. Lands also were granted to settlers on condition that they planted 100 white mulberry trees on every ten acres when cleared; and ten years were allowed for their cultivation. Trees, seed, and the eggs of the silk worm, were sent over by the colonial trustees; and an episcopal clergyman, and a native of Piedmont were engaged to instruct the people in the art of rearing the worms and rearing the silk.† By

* Mr. Gee in his chapter on Trade between England and CAROLINA, remarks, "Carolina lies in as happy a climate as any in the world, from thirty-two to thirty-six degrees of northern latitude; the soil is generally fertile. The rice it produces is the best in the world; and *no country affords better* silk *than has been brought from thence.* The rich grounds that lie under the Apalachian hills, are inviting places for raising silk. If care were taken to cultivate and improve the raising of silk in our plantations, *Carolina, Virginia, Maryland,* and *Pennsylvania,* would produce the best silk, and as fit for organzine as any in the world. The vast riches of China, by this manufacture are sufficient to demonstrate the great advantages thereof; and the extraordinary treasure the Duke of Savoy draws into his country by silk, which is made in that little principality of Piedmont, is also another instance. We may judge, if he draws above £200,000 a year from England, what his profits are which he draws from Holland, and other places where the manufacture is carried on to a great degree. No part of the world is better suited to the silk worm than are our colonies; no silk cleaner, more glossy, of a better body, nor fitter to answer the use of the fine thrown silk we have from Italy, than the small quantity of silk that has been imported from thence. We are told by a gentleman of good intelligence, that the whole charge of making a pound of silk in China, does not stand in above five shillings; and almost any person, man, woman, or child, may work at it; and a woman with a child to direct the thread, may, with a proper machine, *reel* from the cocoons, one pound a day."

† "In order to preserve the spirit of the silk culture, and to keep the views of government present before the people, the public seal had on one side of it, a representation of silk worms, with this appropriate

the manuscript records of those colonial trustees, it appears that the first silk received from Georgia, was in the year 1735, when eight pounds of raw silk were exported from Savannah to England, where it was woven and presented to the queen. It appearing desirable to the government that the home consumption of raw silk should be supplied from the colonies rather than be dependent on foreign states, an act was passed in 1749 for encouraging the growth of colonial silk, under the provisions of which, all that was certified to be the production of Georgia and Carolina was exempted, on importation, from the payment of duty. A bounty was also offered for the production of silk, and an Italian gentleman, named Ortolengi, was engaged to proceed to Georgia, and instruct the colonists in the Italian mode of management.

In a collection of essays published by Doctor Jared Elliot, of Killingworth,* Connecticut, we find many interesting particulars in relation to the early introduction of the silk culture in America. From his writings we learn that Georgia first embarked in the pursuit under the administration of Governor Oglethorpe. Dr. Elliot says, by a late account from Georgia, "it appears that the silk manufactory is in a flourishing way. In the year 1757, the weight of the silk balls"

motto, 'NON SIBI, SED ALIIS,' *not for ourselves, but for others.*"—M'Call's History of Georgia, vol. i. pp. 22. 29.

* By a pamphlet published by the *Society in London for the Encouragement of Arts, Manufactures, and Commerce,* we learn, that in 1761, the following gentlemen, their correspondents, were by them authorized to pay premiums in their respective colonies, "for merchantable raw silk, raised and produced therein," viz. Dr. Jared Elliot, the Rev. T. Clap, president of Yale College, Jared Ingersoll, Esq., of Connecticut. Benjamin Franklin, LL.D., and John Hughes, Esq., of Pennsylvania; George Pollock, Cullen Pollock, and John Rutherford, Esqs., of North Carolina. The premiums were, "for every pound of cocoons produced in the province of Georgia, in 1761, of a hard, weighty, and good substance, wherein one worm only has spun in them, three pence; for every pound of cocoons in which two worms had spun in one cocoon, two pence. So far as Georgia was concerned, the cocoons were to be brought to the filature at Savannah under the direction of M. Ortolengi. Thus it appears there was then a *filature* at Savannah.

(cocoons) "received at the filature was only 1052 lbs. last year produced 7040 lbs.; and this year already above 10,000 lbs.; and it is very remarkable that the raw silk, exported from Georgia, sells at London from two to three shillings a pound more than that from any other part of the world." At the time when Mr. Elliot wrote, 1759, Georgia was increasing in the silk business. A severe loss was sustained by those who had embarked in this enterprise in Georgia, in the year 1758, by the filature and storehouse taking fire, and being consumed together with a quantity of raw silk, and *eight thousand weight* of cocoons. The quantity destroyed enables us to form some judgment relative to the extent of the silk business at that early day. Dr. Elliot says, that in the year when his essay was written, those who had given their attention to the production of silk, informed him, "*that it was more profitable than any other ordinary business.*"*

It appears from other authorities, that the public filature was erected in 1751 by order of the colonial trustees. The exports of silk from 1750 to 1754, amounted to the value of $8880. In 1757, one thousand and fifty pounds of raw silk were received at the filature. In the year 1759, the colony exported upwards of 10,000 weight of raw silk. According to an official statement of William Brown, controller of the customs of Savannah, 8829 pounds of raw silk were exported between the years 1755 and 1772 inclusive. The last parcel brought for sale to Savannah, was in the year 1790, when upwards of 200 weight were purchased for exportation at from eighteen shillings to twenty-six shillings per pound. "There is no doubt that the cultivation of the cotton plant proved so ad-

* He says, "some years past, I asked a man of good faith and credit, who had then made the most silk of any among us, what profit might be made of it? His reply was, that he could make a yard of silk as cheap as he could make a yard of linen cloth, of eight run to the pound. A woman of experience in this business told me, that in the short time of feeding the worms and winding the silk balls, she could earn enough to hire a good spinner the whole year."

vantageous to the planters in Georgia as to become, at the period when the bounty was suspended, a superior temptation."*

The silk culture, it is asserted, commenced in South Carolina about the same time, 1732, as in Georgia, and began at once to be, as it should, *a fashionable occupation.* The *ladies*† *of South Carolina* hesitated not to devote their attention to what had, from time immemorial, constituted the care of a long line of *empresses of the Celestial Empire.* Though the quantity of silk produced, during the first epoch of its culture in Carolina was small,‡ yet we have the highly credible testimony of the celebrated Sir Thomas Lombe, that its quality was excellent and equal to any produced in Italy.§

Authors differ relative to the time when the silk culture was first introduced into Pennsylvania. M. d'Homergue says, "In the year 1769, on the recommendation of Dr. Franklin, through the American Philosophical Society, a filature of raw silk was esta-

* "A paper was laid before the Commissioners for Trade and Plantations, by about forty eminent silk throwsters and weavers, declaring that, having examined a parcel of about 300 lbs. of Georgia raw silk, imported in February last, they found the nature and texture of it truly good, the colour beautiful, the thread even, and clean as the best Piedmont, and capable of being worked with less waste than China silk."—London Magazine for 1755.

† In the year 1755, Mrs. Pinckney, the same lady, who about ten years before, had introduced the indigo plant into South Carolina, took with her to England, a quantity of excellent silk, which she had raised and spun in the vicinity of Charleston, sufficient to make three dresses; one of them was presented to the Princess Dowager of Wales, and another to Lord Chesterfield. They were allowed to be equal to any silk ever imported. The third dress, now (1809) in Charleston, in the possession of her daughter, Mrs. Horry, is remarkable for its beauty, firmness, and strength."—Ramsay's History of South Carolina, vol. i. p. 221.

‡ In the years 1742, 1748, 1749, 1750, 1753, 1755.—Dodsley's Annual Register, 1761.

§ An impartial inquiry into the state of Georgia.—London, 1741, p. 79.

At new Bordeaux, a French settlement, 70 miles above Augusta, Georgia, the people supplied much of the high country with sewing silk during the revolutionary war.

blished at Philadelphia, by private subscription." In 1770, Mrs. Susanna Wright at Colombia, Lancaster county, made a piece of mantua, sixty yards in length, from her own cocoons, afterwards worn as a court dress by the queen of Great Britain. About this time, Grace Fisher made some considerable quantity of silk stuffs.* And we learn that many ladies before the revolution wore silk dresses of their own fabrication.†

The editor of the Genessee Farmer states, that "a filature was established in Philadelphia in 1770, and premiums announced; and that in the following year, 2300 lbs. of silk were brought there to reel." The work on the Growth and Manufacture of Silk, published by order of Congress, in 1828, says that, "in the year 1771, the cultivation of silk began in Pennsylvania and NEW JERSEY, and continued with spirit for several years. The subject had been frequently mentioned in the American Philosophical Society, as one of those useful designs which it was proper for them to promote; but they were induced to enter into a final resolution on it in consequence of a letter being laid before them, on the 5th January, 1770, from Dr. Franklin, who was then in London as agent of the colony, and in answer to one which had been written to him on the same subject by the late Dr. Cadwallader Evans. In this letter from Dr. Franklin, he recommended the culture of silk to his countrymen, and advised the establishment of a public filature in Philadelphia. He also sent to the Society a copy of the work by the Abbe Sauvage, on the Rearing of Silk Worms. A committee having been

* Of which, a piece was presented by Governor Dickenson to the celebrated Catharine Macauley.

† At a large meeting of silk growers held at the Hall of the Franklin Institute, on the 29th of January, 1839, a few days before writing this article, Dr. Mease of this city presented several specimens of silk woven and dyed about the time mentioned above, which were truly creditable, and which the venerable speaker facetiously remarked, though not as splendid as much of that manufactured in these days, would still, notwithstanding, "make a very fine show in a country church."

appointed by the Society to frame a plan for promoting the culture, and to prepare an address to the legislature, praying for public encouragement, they proposed to raise a fund by subscription, for the purchase of cocoons, to establish a filature, and to offer for public sale, all the silk purchased and wound off at the establishment; the produce thereof to be duly accounted for, and to remain in the stock for carrying on the design. A subscription among the citizens was immediately set on foot, and the sum of £875, 14*s.* obtained the first year;" "£900 (or $2400,)" says M. d'Homergue.* The worms were fed on the native mulberry until the white mulberry could be reared, and it is remarked that they thrived well and yielded good silk. By the several members of this association, whilst it was in existence, not only good silk was procured, but, as we are told, even many garments were obtained. But soon after, war, which often is another word for *destruction* to what God hath made, or *confusion* where *order* should exist, put an end to this good beginning, and even buried the whole, however high the promise, in oblivion.

During the whole of the most discouraging circumstances, not only in the revolutionary war, but through that apathy created in the public mind by any disturbance in commercial connexions, this noble enterprise seemed rather to slumber than to die, and all the energies of its spirit are yet alive waiting for its resurrection. One of the early discouragements in the production of silk, was the want of a market either

* M. d'Homergue, is a competent witness, since he was in the whole of this part of the history, relative to Pennsylvania, highly interested. He also adds, "I have been told that a Frenchman skilled in the art of reeling was employed in the establishment. Who he was, or what became of him afterwards, I have not been able to learn. I have not heard of any raw silk having been prepared at this filature, or sold out of it: yet I have been told that a lady of this city," (Philadelphia,) "had a *négligée* dress manufactured in England out of silk of her own raising. The lady's name was *Roberdeau*." Query. Was this the lady or a relative of the well known General Roberdeau, of the revolutionary war, remarkable for his unaccountable feline antipathy?

for the sale of cocoons, or for reeled silk; and another has been the too prevalent idea of supposed difficulty in the filature. These obstructions are now extinct. Ready markets, not only in the eastern cities, but almost anywhere are established and on the increase through the Union. And the simplicity of the reel and spinner invented by Mr. Gay, has reduced the art of reeling and making sewing thread to the level of any capacity.

At Economy, Pennsylvania, the culture in all its branches, from the feeding of the worm to the manufacture of the silk, is extensively carried on by Messrs. Rapp and his industrious coadjutors. And the produce of that laudable establishment, we are informed, has received the approbation of connoisseurs.

We have now arrived at a crisis, which is perhaps as important as any period in the history of the culture of silk in North America, and, therefore, cannot here, withhold from our readers, all the information we can derive relative to this eventful era; which is succinctly drawn up to our purpose in a pamphlet, or Report on the Mulberry and Sugar Beet, published during the second session of the twenty-fifth Congress;* in which, at page five, we read as follows:

"There were, perhaps, some other reasons which induced the people of this country to neglect this subject (the culture of silk) for so long a period. The white Italian mulberry, till within a few years, was the only variety cultivated, and this was unfit for use for several years. So that the cultivator was compelled to lose the use of his capital and labour for some years, before he had any prospect of remuneration. Add to this, the extreme difficulty, which, till very recently, attended the process of reeling, and the want of a market for cocoons or raw silk, and we have causes sufficient to satisfy any reasonable mind, that *the culture of silk was never abandoned in this country on account of the soil or climate.*"

* Rep. No. 815.

Now, "the cultivation of the white mulberry has been substituted by the *morus multicaulis*, which may be stripped of its foliage the same year that it is planted; and the dull, tedious process of reeling by hand, which required a regular apprenticeship to learn, and years to acquire any facility, has given way to new improvements in the reel, by which a person (even a child) may learn in a few hours to reel with ease and expedition. Many silk weavers, also, and public establishments have opened a good and permanent market for all the cocoons and raw silk that can be raised, for want of which they are yearly under the necessity of importing large quantities to keep their factories in operation."

It is asserted that Mr. N. Aspinwall, who had a plantation of mulberry trees on Long Island, was the means of introducing the white mulberry tree, and the eggs of the silk worm, in the year 1760, into the town of Mansfield in Connecticut. He also planted an extensive nursery of the trees in New Haven; and together with Dr. Ezra Styles obtained from the state legislature a bounty of ten shillings for every hundred trees that should, in three years from the time of planting, be in a healthy condition, and also of three pence per ounce for all raw silk which the owners of the trees had produced from cocoons of their own raising within the state. After the public encouragement for raising trees was found unnecessary, a small bounty on raw silk, manufactured within the state, was continued some time longer. A statute yet continues in force, requiring sewing silk to consist of twenty threads, each two yards long.*

Dr. Lardner bestows the highest eulogium on the Society for the Encouragement of Arts, and particularly for their patriotic endeavours to promote every thing, at home or abroad, connected with the production or manufacture of silk. In this sentiment, the

* Report published by order of Congress in 1828.—Roberts' Manual and Silk Grower.

work published by order of Congress in 1828, concurs, in the following language. "It would be an act of injustice to omit noticing the generous encouragement to the cultivation of silk in the American colonies, which was given by the patriotic Society in London, for 'the Promotion of Arts,'" &c. From the year 1755 to 1772, several hundred pounds sterling were paid to various persons in Georgia, South Carolina, and Connecticut, in consequence of premiums offered by the society, for planting mulberry trees, for cocoons, and for raw silk.*

It may be remembered that Count de Hazzi divided the whole of the history of silk culture in Germany, into three periods; the two former of which he calls the "unlucky." And it is too evident almost to escape observation, that the same culture in North America is as clearly divisible into three periods; but we have no warrant to pronounce the two former unlucky. On the contrary they were successful, but not to that degree they would have been had impediments already specified not existed. *The first period may be said to have continued from the first introduction of the silk culture in North America, in* 1623 *to the close of the Revolutionary war in* 1783, *or for* 160 *years. The second epoch, &c. from that event to the time when there was in this country* public *evidence of* decisive *knowledge of the character of the multicaulis mulberry; or to July* 1830.

The second epoch then in the history of the American silk culture, commenced in 1783. Notwithstanding the desolation generally introduced by war, which when internal has too frequently a continued and universal effect, the silk enterprise was, though somewhat gradually, renewed. It was precisely at this period, 1783, that the legislature of Connecticut, induced by the exertions of Dr. Aspinwall and the Rev. Dr. Styles, granted a bounty on mulberry trees

* Bayley's Advancement of the Arts, London, 1772. Dossie's Memoirs of Agriculture, vol. iii.

and raw silk. In 1789, 200 lbs. of raw silk were made, in Mansfield, which, in 1793, produced 365 lbs. of raw silk. In 1810, the sewing and raw silk of New London, Windham, and Tolland, were valued by the United States marshal at $28,503, exclusive of the amount of domestic fabrics; and double this entire amount is said to have been manufactured there in 1825. So popular, indeed, had silk products become about this period, that they were readily taken and paid there, as a circulating medium.

We are informed, that Samuel Chidsey of Cayuga county, New York, during the late war with England, sold sewing silk to the amount of $600 a year. The cultivation of silk commenced, in the same era, in the states of Ohio and Kentucky; and also by certain French settlers in the country, now the state, of Illinois.

An important era to North America, was now about to dawn, and a spirit of universal inquiry seemed to be excited. The several impediments to the successful culture of silk, whatever they were, that had aforetime somewhat fettered this noble enterprise, were giving way in succession, and daylight appeared to break out on the American people before they were actually aware of it; and were we allowed to indulge in the figure, we should say, that this twilight, or crepuscular period commenced in the year 1825. We now see that not only individuals, farmers, and planters, but also legislators, have risen from a comparative lethargy. Not only *private*, but *national* interest, is on the tapis. Neither can any sceptic, any *cool* calculator or *frigid* political economist, negative the question, may not the United States become equal in wealth and independence, and infinitely superior in intelligence, to the China of 4000 years? The climate, the soil, the cocoons, the filature art, the throwsting, the *tout ensemble*, are now reached out to Colombia, and strange would it be, if she find not the hand to grasp the boon that soon shall envy not the mines of Mexico, but prove that *silk* is the first,

and *cotton* only the second staple of North America. An interest, therefore, that not only points to every individual pocket, but vast enough to look a whole nation in the face at once, is now before us.

We have said that the day dawned, and even legislators were risen, and on their feet in 1825. Mr. Miner, of Pennsylvania, inquires in the house of representatives on the 29th of December, "if the cultivation of the mulberry, and the breeding of silk worms, were a subject worthy of legislative attention." In 1826, Mr. Van Rensselaer made a report, which led to the resolution that the secretary of the treasury should cause to be prepared a Manual on the Growth and Manufacture of Silk. In 1828 when Mr. Rush presented his Manual, Dr. Mease transmitted to the speaker the Treatise of Count de Hazzi. These were followed by a report presented to the house by Mr. Spencer, in 1830, embracing two interesting letters from Peter S. Duponceau, Esq., of Philadelphia, and Essays on American Silk, by M d'Homergue. These documents comprise the most valuable instructions on the subject of the silk culture. The report proposed to grant to M. d'Homergue the sum of $40,000 for the establishment of a normal school of filature in Philadelphia for the gratuitous instruction of sixty young men for two years in the various branches of reeling, manufacturing, and dyeing silk. This bill, though favourably received, was not, through various causes, acted on at that session. In 1832 the bill was brought under legislative consideration, and for reasons best explained in *Mr. Duponceau's History of the Silk Bill*, defeated by a small majority. "Thus perished," says Mr. Randolph, "the first important measure, proposed by the nation, to promote the production of silk in this country; a measure which the committee (on agriculture*) believe, with the lights then in existence, was wise, prudent, and important; but which the subsequent

* Twenty-fifth Congress, second session.

ingenuity and experience of our countrymen now render unnecessary; believing, as they do, that the recent improvements in reeling will do more in a few weeks, than the establishment of many normal schools on the old plan would do in many years."

The third epoch in the history of silk in the United States may be dated *not* from the time when the first multicaulis tree existed in this Union, which was in 1826,* but from the moment when there was, in this country, *public* evidence of any *decisive* knowledge of its character: and this was the case in July, 1830. According to the accounts before us, the well known and justly celebrated Mr. Gideon B. Smith of Baltimore possessed the first† tree of this kind in North America; but does not appear, from the treatise he published in 1830, to have then had sufficient acquaintance with its peculiarities, to warrant him in recommending it as a valid substitute for its popular predecessor, the Italian mulberry. But Dr. Felix Pascalis, of New York, having, in the preceding March, imported two multicaulis plants, comes forward, in July, 1830, with a *decision* at once so clear, that it has since gone by the name of Dr. Pascalis' prediction. In an article in the Journal of Sciences for July, 1830, after informing us that he had received two trees of this mulberry from France, adds, "*After the discovery of this plant, a doubt no longer exists, that two crops of silk may be raised in a single season.*" A prediction almost immediately after verified, in the summer of 1832, in Madame Parmentier's Horticultural establishment on Long Island.

After this period, we have ample testimony that the general impetus existing in the public mind, was on the onward march, and though at first with a pace compa-

* The difference of one or even of two years will, perhaps, be contested, by some in the state of New York, or elsewhere; but this point is not important, since it is not from the possession, but from the *public* evidence of any *decisive* knowledge of its character, that we date the epoch in question.

† See Silk Grower, vol. i. p. 147.

ratively slow and cautious, yet steadily advancing with an increasing rapidity such that it was evident that it would soon have to dispute with every other staple within the limits of the Union. Excitement, whatever it be, is always prolific: a month effects more than a year: it is an age, and that the age of invention. Difficulties, though mountains before, vanish, and the toil of a man becomes the sport of a child. New reels and improved systems of reeling appear by the dozen, the facilities of filatures are already in the rear, and markets for cocoons and silk in any shape, are on the right and left—the winter is past—the difficulties are gone; and all we have to do, is to go up at once, since we are able, and possess the goodly land. "*Possunt, quia posse videntur.*" When Providence does any thing for man, his business is to co-operate. It has done much for us; has given soils and climates positively omniferous; China herself boasts of nothing superior: we cannot do wrong in stepping on the traces of 4000 years.

In pursuing the subsequent history of this important, but yet comparatively prospective branch of agriculture, we cannot do better than refer to the letter of Mr. Andrew Judson of Connecticut, late a member of Congress, to the Hon. J. Q. Adams, and furnished by the latter, as chairman of the committee on manufactures, to the congressional house of representatives, on February 25, 1837. We find that it covers a large surface, however paradoxical, in a little compass.

In an early part of this letter Mr. Judson confers a very flattering compliment on the *Hartford County Silk Society*, to whose patriotic efforts in disseminating a knowledge of the silk culture, by the publication of the well known periodical, the *Silk Culturist*, under the editorial charge of their secretary, *Judge Comstock*, and by other means, he attributes "the present state (January, 1837) of these branches of American industry, and the interest which is so extensively felt in relation to them." We are our-

selves, in short, so sensible of the benefit derived from this source, a sentiment we are assured that we maintain in common with many, that it is but a *just** *return* to inscribe this, since we cannot on the marble bust, as a record on the page of history.

So far as experiments are the cost of time, and issue in results profitable and available to the community, their verdict is the matter of history; we, therefore, hesitate not to make here such extracts from this interesting letter as have a direct reference to the public interest. "Experiments have been made in all parts of the country, and their success has established the fact, that *the mulberry will grow, and the silk worm thrive, throughout the whole length and breadth of the United States.* It was formerly doubted whether the morus multicaulis could be acclimated in the northern and middle states; but late experiments have satisfactorily proved that, by cutting down the shoots in autumn, the roots will endure the coldest winters, send up a new growth of shoots in the spring, and produce an abundant crop of foliage. This appears to be the method successively pursued by the silk growers in India; and with the same treatment in this country, there is no doubt of its acclimation. The facility with which it is cultivated and multiplied to an indefinite extent, affords *a full guaranty against those failures and interruptions in the business to which it has heretofore been subjected.* It has been ascertained by experiment, that the foliage which may be gathered from annual shoots on *an acre of land will furnish food enough to sustain a family of worms sufficiently numerous to make* 128 *pounds of silk, worth, at present prices,* $640."

The importance of the remarks in the following extracts will be readily perceived. "The process of *reeling*, also, which was formerly supposed to be of

* The merely nominal price at which the Silk Culturist was published, together with the *gratuitous* distribution of mulberry seed and silk worm eggs, argued loss rather than profit to the company.

difficult performance, has been so familiarized, that children perform it with skill and dexterity. The gathering of the foliage, and the feeding of the worms may be effected by the children, and such other members of the family as are incapable of more arduous labour; one aged person being always in the direction of the business as a responsible head; and who, if not thus employed, would spend their time in idleness; or, what is worse, in mischief. *If productive labour is a source of wealth, both to nations and individuals, it is desirable that it should be increased to its greatest possible extent. This can only be done by seeking out objects to which the labour of the young, old, and infirm is adapted; and among these, there is none more appropriate than the culture of silk. The same remarks are substantially true with respect to its manufacture.* It has also been erroneously supposed, that the manufacture of silk was attended with extraordinary difficulties; that it required much complex and expensive machinery, and a skill which Americans were incapable of acquiring; but it has been found to be as simple as that of cotton or wool, and requiring a far less expenditure in buildings, machinery, and fixtures. The weaving of silk fabrics on power looms has been attempted, and the success that has resulted from the experiment, is of the most flattering character. Fabrics for gentlemen's wear, cravats, &c. have been woven on power looms, which, for beauty of texture, fall but little, if any, below those of foreign manufacture. In this respect we are already in advance of the silk manufacturers of Europe and India; and it is believed that the advantage the American manufacturer will derive from the aid of labour-saving machines, will more than counterbalance that which the foreign manufacturer can derive from the reduced price of labour in countries of a more dense population. Hence we are confident that this country can successfully compete with others both in the culture and manufacture of silk."

"The importance of introducing this species of manufacture may be estimated by the fact, that the importations of manufactured silks, during the year ending the 29th of September last, amounted to $17,497,600, being nearly a million more than the previous year. Most of this vast amount is consumed in this country, which is an enormous tax on the consumers. It is also to them and the country a total loss; for it is believed that we have a sufficient number of labourers to produce and manufacture the whole amount, who are unproductively or unprofitably employed. If this be so, it follows as a necessary consequence, that we *sustain an annual loss of* DOUBLE *that amount* in our *unemployed* and *misapplied* labour. This amount will also be *astonishingly increased*, if we add to it all the evils of crime and pauperism, which are the legitimate and unavoidable consequences of idleness and unproductive labour. *The importance, therefore, of the culture and manufacture of silk, both in a pecuniary and moral point of view,* IS IMMENSE.

"The importance of this branch of rural economy is also much increased, by the facilities it affords to all to attain competence and wealth. There is probably no other business in which the same amount of capital will yield an equal amount of income. There can be no better investment. The small amount too, necessary to a commencement of the business, is also an encouragement which no other holds out to the enterprising. *A few acres of land of ordinary fertility, and a few dollars in money for the purchase of seeds and plants, will enable a silk grower to lay the foundation for a plantation on a considerable scale.* Another facility peculiar to the business is the ease with which operations are extended, without a corresponding extension of capital. *The ratio in which the morus multicaulis may be multiplied, by means of cuttings and layers, is astonishing.* Experiments have proved that, with a little labour and attention, *they may be more than*

QUADRUPLED *every year.* This will enable the farmer in moderate circumstances to compete with the capitalist, and prevent monopolists from engrossing the whole of the business and its profits. To the individual of limited means, having a large family of children, the culture of silk holds out encouragement of extraordinary promise; while, at the same time, it affords ample opportunity for the capitalist or the incorporated company to make large investments with the moral certainty of success.

"The culture and manufacture of silk must also, for a long time, be free from the depression and embarrassments which, at times, are thrown on other species of manufacture by enterprise and competition. *Before the present prices can be materially reduced, an amount of domestic silk* EQUAL *to the large amount annually imported must be produced;* and this cannot be expected, whilst enterprise and labour have so many objects on which to expend themselves, as the various sections, climates, interests, and pursuits of this extensive country present. The disposition also which has existed for the last twenty or thirty years, between the increase in the consumption of silk and the increase of population, *will* it is believed, *prevent the American silk growers,* with all the aid and encouragement which may be extended to them by the national and state legislatures, *from producing the raw material in sufficient quantities to satisfy the demand, for at least another century.*"

The above convictions so ably expressed by Mr. Judson, and so directly relevant to our interests, and admirably calculated to remove every doubt in the mind of the most uninformed or sceptical, are the results of *experimental history.* History, in short, is nothing without its moral development; and viewed in this light, the preceding extracts cannot be considered as a digression from the subject of this section. The detail of facts, however, Mr. Judson prefaces, by informing us, that in the month of the preceding Sep-

tember, he had caused a circular to be prepared, propounding twenty-six interrogatories to silk growers, manufacturers, and other gentlemen interested in the subject; and that several hundreds were circulated. "The facts, however, collected, are of the most flattering character. From the answers to the interrogatories, the communications of gentlemen in different parts of the country, and such other means of information as I have been favoured with, I am enabled to give the following exhibition of the progress and prospect of both branches of the business. The statements being made from correct data, may be relied on, as approximating to accuracy, so far as they go; but it is reasonable to suppose that the view is imperfect, as the business has probably been commenced in many parts of the country, from which no information has been received."

Indeed so wide is this country that in it millions may exist, or live and die, unknown to others; and much more their avocations, designs, or prospects. The precise outline, therefore, of the American history, as it relates to silk or any other object, cannot be fully caught, at any given moment. The historian often has to wait till time's pendulum measures his eventful revolutions by deeds, and until their report has had weeks, months, and even years, to travel to his eye or ear, and announce such prospects as their relative circumstances may warrant in his estimation. Under this view of the case we may be allowed to close our history of the silk culture and manufacture in America, with such extracts from Mr. Judson's authentic testimony as refer to the different sections of this Union.

"THE SIX NEW ENGLAND STATES

"Are more or less engaged in the culture and manufacture of silk; and four of them are encouraging the business by legislative bounties. In MAINE, a bounty of five cents on every pound of cocoons grown,

and fifty cents on every pound of silk reeled, is paid from the state treasury. The experiments which have been made confirm the belief that the climate is no obstacle in the way of the silk grower. In *Newport*, *Fryeburg*, *Saco*, *Hiram*, and *Limington*, nurseries have been planted, and are said to be in a flourishing condition. Within a few miles of the forty-fifth degree of latitude, the young plants withstood the severity of last winter. A gentleman in Fryeburg fed last season 5000 worms, which produced the usual quantity of silk. In NEW HAMPSHIRE the business has been begun, and is prosecuted with considerable spirit, though no public encouragement is given. At *Concord* there is an incorporated company, with a capital of $75,000, for the growth and manufacture of silk. The company has purchased a farm of 250 acres, and is stocking it with both kinds of the mulberry as fast as circumstances will permit. Individuals also, in most parts of the state, are planting the mulberry preparatory to feeding the worm. Experiments have also been made in *South Weare*, *Newport*, *Dunbarton*, *Warner*, *Hopkinton*, *Keene*, and many other towns, and the results have evinced, that the business is both practicable and profitable.

"The legislature of VERMONT, have authorized the state treasurer to pay a bounty of ten cents on every pound of cocoons grown within the state. In *Burlington*, *Brattleboro'*, *Woodstock*, *Middlebury*, *Bennington*, *South Hero*, *Montpelier*, *Orwell*, *Shoreham*, *Guilford*, *Putney*, and other places preparations are making on a large scale. The legislation of MASSACHUSETTS, for the encouragement of the growth of silk, is of the most liberal character. The bounty on all silk grown, reeled, and throwsted, in the commonwealth is two dollars a pound; which is considered by silk growers to be sufficient to defray all expenses attending its growing, reeling, and throwsting. There are several incorporated companies. Amongst them is the New England Silk Company at *Dedham*, under the superintendence of Mr. Cobb.

This company has a capital of $50,000 with liberty to extend it to $100,000. Mr. Cobb says, "we have sixteen sewing silk machines. We have found organzine and tram, or warp and filling, to be in greater demand than heretofore; but in consequence of the forty per cent. protection on sewing silk held out by government, we have been building a large mill, and are now ready to manufacture 200 lbs. per week of sewing silk, which, at present prices, will bring $2000. About $10,000 worth of silk goods, part with a mixture of cotton, have been manufactured here the year past." In addition to this, Mr. Judson notices the Atlantic Silk Company, at *Nantucket;* the *Northampton*, the *Massachusetts*, the *Boston*, the *Roxbury*, and the *Newburyport* Silk Companies; all with adequate capitals, and "promising prospects."

"In Rhode Island the manufacture of silk is commencing. The Rhode Island Silk Company has a capital of $100,000. The factory is at *Providence*, and the plantation in the neighbourhood. It has manufactured some very beautiful and durable articles.

"In Connecticut silk has been grown in considerable quantities for fifty or sixty years, particularly in the counties of *Windham* and *Tolland*. The state pays a bounty of one dollar on every hundred Italian or Chinese mulberry trees, set out at such distances from each other as will best favour their full growth and the collection of their leaves, and cultivated until they are five years old; also a bounty of fifty cents on every pound of silk reeled on an improved reel. There are two incorporated companies, the Mansfield and the Connecticut. The former is located at *Mansfield*, and has a capital of $20,000; the latter at *Hartford*, with a capital of $30,000. There is also a silk factory at *Lisbon*. Individuals also, in all parts of the state, are engaging in the culture. There are likewise extensive nurseries at *Hartford, Suffield, Farmington, Litchfield, New London, Stonington, Durham, New Haven*, and many other towns."

MIDDLE STATES.

"The subject of encouraging the culture of silk has been under consideration in NEW YORK, and it is expected will be given at the present session. Several silk companies have been incorporated, among which are the *Troy*, the *Poughkeepsie*, the *New York*, and the *Albany* Silk Grower's Companies. In all parts of the state, individuals are engaging with spirit; and there is no doubt New York will become a great silk growing district.

"In NEW JERSEY several companies have been incorporated, among which are the New Jersey and the *Monmouth* Silk Companies. Several others are formed, and enterprising individuals are engaging in the culture. The soil and climate have been found well adapted to the business." This state pays a bounty of sixteen cents a pound for cocoons, and fifty cents a pound for reeled silk.

"A number of companies have been formed in PENNSYLVANIA, under a general law of the state for the encouragement of the culture of silk." The *Beaver*, *Chester*, *Philadelphia*, and *Economy* Silk Companies, are those which Mr. Judson notices in 1837. A number of companies have sprung up during the past season and others are almost daily coming into existence.

"In DELAWARE and MARYLAND, the subject is attracting much attention. Several companies have been formed, and individuals are commencing plantations." The Queen Anne County and Talbot Silk Companies are mentioned.

SOUTHERN STATES.

"In the Southern States much interest is felt in the subject, and much is doing to introduce it to the attention of planters. In VIRGINIA, they are proposing to devote their worn-out tobacco lands to the culture of silk, in the hope of checking the tide of emigration,

which is setting west, and threatening to depopulate the country. There are several silk companies, and many individuals are making experiments. The accounts I have received from NORTH CAROLINA are of the most cheering character. They represent the soil and climate to be remarkably favourable to the growth of the tree and to the rearing of the worm. The same is substantially true as respects SOUTH CAROLINA and GEORGIA. Experiments have been made, whose results have satisfied the planters that the young, aged, and infirm portion of their slaves can be profitably employed in the culture of silk: and there is little doubt that in a short time many of them will make a silk as well as a cotton crop. In FLORIDA and ALABAMA the tree grows luxuriantly, and produces an abundance of foliage. Experiments in rearing the worm have also been attended with favourable results; and a portion of the inhabitants are convinced that silk will be the most profitable crop they can make. At *Pensacola* and *Mobile* are large numbers of mulberry trees; and arrangements are making to commence the business. The black mulberry is there indigenous, and its foliage has been found to make as good silk as that of the Chinese. It is also supposed that the sterile lands of West Florida will become valuable on account of their adaptation to the production of silk."

WESTERN STATES.

The soil and climate of the Western States, has also been found to be peculiarly adapted to the silk culture. In OHIO there are a number of companies incorporated with large capitals, and under the direction of skilful managers. In the vicinity of *Canton*, in *Stark county*, seventy families are engaged in making silk; and in *Knox*, *Cuyahoga*, *Jefferson*, *Belmont*, *Washington*, *Brown*, *Hamilton*, *Montgomery*, *Highland*, and several other counties, many individuals are beginning. The subject is new in

KENTUCKY, but as is evident from the following extract of a letter, is attracting attention. "The first talk of silk raising in this country was about a year and a half since, when a friend sent me the first copy of the Silk Culturist. So great has been the increase of public sentiment, that there appear but few of the rich farmers who are not contemplating it as a source of employment for their weak force. The six that are now making experiments, can bring into the field one hundred hands, and our whole energy will be turned to it. In INDIANA large quantities of white mulberry seed have been sown, and a spirit of inquiry has been awakened. The business cannot flourish with us till our trees have grown, though our woods abound with the black mulberry. In ILLINOIS, MISSOURI, and TENNESSEE, small beginnings have been made, and the congeniality of the soil and climate cannot, ultimately, fail of making them great silk growing states. Could a general diffusion of practical knowledge on the subject of cultivating the tree, and rearing the worm, be effected, I have no doubt the United States would become one of the greatest silk growing countries in the world."

Beyond the period to which these brief extracts from Mr. Judson's highly credible testimony relative to the general state of the silk culture in this country refer, it is, at present, unnecessary to pass; particularly as the progress since, has been so rapid, that to delineate, with any precision, the whole at any exact moment, over so wide a field as that of the United States, would be impossible, unless furnished with facilities similar to those which Mr. Judson's official commission for inquiry commanded.

PART II.

ON THE MULBERRY TREE.

CHAPTER I.

MULBERRY, GENUS, SPECIES.

THE first thing to be done towards either the production or manufacture of silk, is a provision of food for the thrifty insect, that will take due care to perform its part, if only we are equally industrious to perform ours; and its only proper and legitimate aliment is the leaf of the MULBERRY TREE.

The *Morus** of botanists, a GENUS† of the TETRANDRIA ORDER, belonging to the *Monoecia class* of plants;

* *Morus*, Lat. a mulberry tree; said by some to be derived from the Celtic word *Mor, black*. But μωρον, the mulberry, is probably from the adjective μωρος, *insipid*, since the fruit of every species, except the red, is comparatively insipid.

† Order, tetrandria. Calyx four-parted, divisions oval and concave; corolla none; stamens four, situated between the divisions of the calyx; filaments erect, subulate, longer than the calyx, and supporting the anthers. Female flowers, growing sometimes on the same individual, and sometimes on a separate plant, have a calyx with four leaves, rounded, obtuse, and persistent; the two opposite exterior ones approaching each other: corolla none; pistil naked; germ, heart shaped, surmounted with two oblong, subulate, rough, strong styles, terminated by simple stigmas; no pericarp; its place supplied by the calyx, which is converted into a fleshy succulent berry, containing one, sometimes two, pointed oval seeds, of which one is usually abortive; perisperm whitish, fleshy, of the same form as the seeds, receiving the embryo reversed, bent into hooks. Cotyledons oblong, foliacious, smooth, narrow, bent over one another. The upper radicle is cylindrical. Distinctive character, monoecial flowers. Calyx four-parted, corolla none, stamens four, styles two, pericarp none, calyx changed into a flesh berry. The female flowers are numerous, collected rather loosely in a common receptacle. Each germ is changed into a succulent berry. These three particularly refer to the mulberry, white, red, or black. They extend their roofs deep, large, and

of which Linnæus mentions seven distinct SPECIES, viz. 1. *Morus nigra;* 2. *Morus rubra;* 3. *Morus papyrifera;* 4. *Morus tinctoria;* 5. *Morus indica:* 6. *Morus tartarica*, and 7. *Morus alba*; of which we shall treat in due order.

The above, it is to be observed, are ranked by Linnæus as SPECIES; and if species, they are each respectively capable of reproduction from its own seed.

There are besides VARIETIES of each species; or kinds produced by two or more species, whose properties have been combined by proximate influence or artificial culture, as ingrafting, inoculating; and even, in certain cases, other varieties obtained by a change of soil or climate; most, if not all of which, however, are HYBRIDS; and consequently, incapable of reproduction from seed.

But what are *varieties* only, and what *hybrids*, have not as yet been distinctly stated, either by the botanist or the horticulturist; and, therefore, until experiments of a satisfactory character are made, we shall refer both the latter to a distinct chapter.

The mulberry tree has many properties such, as if it had been endowed by nature with every requisite to render its cultivation, wherever that be, in the hedge, in the plantation, in the cornfield, or as an ornament around our premises and dwellings, an object happily combining utility, convenience, and pleasure. Independently of the primary purpose of its culture, the production of an agreeable and elegant article of clothing, in consequence of its roots, not obliquely but more deeply and perpendicularly striking into the earth, it leaves the surface less impoverished and incommoded than it is by many trees. The ground, therefore, between mulberries, or their rows, may, in many cases, be successfully occupied with

branching. They are exceedingly vivacious, and put forth rapidly. *When grafted they die after twenty-five years; while the mulberries not grafted will live, sometimes, through three centuries.* There are mulberry trees in England and France, *known* to be of this age.

other products; particularly since neither the shade of the tree, nor the dropping of rain from its leaves, is considered prejudicial to plants growing beneath. It is also a matter of universal observation that no insect, except the silk worm will feed on the mulberry leaf. The experiment was purposely tried by M. Pullein, which satisfactorily demonstrated that the product of this tree is the *exclusive property* of the silk worm, or *the insect, which apparently works only for man.* "During the continued observation of three years, Miss Rhodes never once found any other insect on the leaves used by her. Other fruit trees and vegetables in the same garden were sometimes covered by myriads, while the mulberry tree, surrounded by these ravagers, remained sacred from their depredations." Not even the aphides invade the tree so *exclusively devoted* to the little operative that so *exclusively devotes* itself to us.

"All the different parts of the mulberry," says Seignor Tinelli, "are useful and good for some purpose or other. Its leaves form the only food that experience has found to be appropriate to nourish the silk worm. The leaves of a second growth, serve, at the close of autumn, as an excellent nourishment for cattle and sheep.* The body and larger limbs, may also be converted into boards of a beautiful yellowish colour,† and finely clouded, for the use of the cabinetmaker; the fibrous epidermis of the young branches, that are often cut, either for the purpose of ingrafting or of pruning, and directing the shape of the tree, if macerated in lime and water, may be made into paper, that is exceedingly delicate and shining, and properly called *silk paper.* The young mulberries take the most beautiful forms that it is possible for the hand of man to give them; and thus this

* "It being understood, however, that the second gathering ought not to be made till the vegetation of the plant has entirely ceased, and the sap has begun to descend from the branches."

† "Citron colour, more or less deep."—Morin.

plant so rich in its produce, furnishes also an elegant ornament in parks and gardens, and in the avenues to villas and country houses."*

Relative to what mulberry trees are distinct species, and what only varieties, the greatest discrepancy and want of distinctness, as already observed, are found in the works of the most popular writers on this subject. The real case, no doubt, is that sufficient trial has not yet been made to determine which of the several kinds are producible, without variation, from their own seed, and therefore distinct species; and which are not, and consequently hybrids, or the mere creatures of local and accidental circumstances, or to be sustained only by artificial culture. Until this interesting, as well as important point is *satisfactorily* ascertained, we prefer, as to those we quote as species, to abide by the Linnæan classification, sanctioned by Dr. Lardner, as good authority; though at the same time, we doubt not, but that some of the kinds not yet ranked as species, will eventually, by further experience, be proved to be such.

Species I. Morus Nigra, or *black mulberry*, a native of Asia Minor. The leaves are large and rugged. Its fruit is large, black, aromatic, juicy, subacid, and good. The leaves will answer for the food of silk worms; but those of other kinds are more suitable. It is much used, however, in Persia, where good silk is produced: the European red mulberry is said to be a variety of the *black*, and is used in Calabria, and in some parts of Italy.† It rises from twenty-five to thirty feet.

The morus nigra never has been extensively used where the morus alba was known. "The sewing

* See "Hints on the Cultivation of the Mulberry," dedicated to the American Institute, by Seignor Tinelli, LL.D., or Silk Culturist, tom. iii. p. 36 *et seq.*

† See Silk Culturist, vol. ii. p. 134, col. 1 and 2; also p. 158, col. 3, *et seq.* On page 3 of the same work, we read, "The black mulberry grows spontaneously in the wilds of some of the southern and western states. The worms will eat the leaves and thrive upon them, but the silk they make is of a very inferior quality."

silks of Naples are mostly made from the silk grown in Calabria, where the worm is fed principally on the *black* mulberry, and which makes the strongest and best of sewing silk. Finizio* stated that the worm fed on the black mulberry made the *strongest* thread; that on the white mulberry *finer* and better for fabrics."† The relative fineness of silk produced from the black and white mulberry may be compared to that between hemp and flax in linen.

Species II. Morus Rubra, or the *red mulberry*, a native of America.‡ The leaves are large, cordate, often palmated, and more often two or three lobed, denticulated, dark green above, downy beneath, rugged. The fruit is of a very deep red or black colour, an oblong shape, and of an agreeable, acidulous, sugary taste. It is composed of the union of a great number of small berries, each of which contains a minute seed. The tree often exceeds sixty feet in height, and two feet in diameter. The wood is of a yellowish hue, aproaching to lemon colour, fine grained and compact, and durable as the white locust. Several varieties of this tree are quoted, viz.

1. Leaves all orbiculated (round.)
2. Leaves deeply lobed.
3. Leaves with three short lobes.
4. Fruit berries nearly white.
5. Fruit berries bluish purple.
6. Fruit berries red and long.
7. Fruit berries blackish red.

Though the red mulberry is said to be peculiar to

* An extensive manufacturer of sewing silks at Naples. He makes about 3000 lb. a week, *mostly for the New York market!*

† Silk Cul. from letter of General Tallmadge, p. 133, col. 3.

‡ "Michaux assigns the same limits north to it as to the majestic and beautiful tulip tree, (lirisdendron tulipifera,) viz. the northern extremity of Lake Champlain; but it also grows in Massachusetts. Southward and westward it abounds in all the states, and has recently been found as far west as the lower part of the river Canadian, by Dr. James, U. S. Army."—Annals of the Lyceum, New York, vol. ii. p. 246.

America, yet in the Silk Culturist, p. 134,* we read as follows. "The red mulberry is here, (south of Italy,) principally used, and is known as the Calabria mulberry. It is described as having a dark fruit; the tree is like our black, and when I called it the black mulberry, I was corrected, and told *that the* STAIN *of the fruit was red, which gave the character of the tree.*"

The experience of more than a century has established the fact, that the leaves of the red mulberry agree perfectly well with silk worms, and yield very good silk; it is, therefore, somewhat singular that M. Deslongchmaps should assert that *the leaves do not suit the constitution of French worms!* Yet Madame Humbert† in Louisiana, and Mr. Seth Millington‡ of Missouri affirm that the insects evinced no preference between the leaves of the white and red species, but that the silks produced from both "were stronger and finer than that of France." Preference is, notwithstanding, generally given to the leaves of the white mulberry.§ Much evidence, the detail of which is too long for our limits, in favour of the American red mulberry, is given in the Silk Culturist, vol. ii. p. 172, col. 3, and p. 173.

Mr. S. R. Jones‖ affirms that in its native state, it yields a large quantity of leaves of a bright glossy green, and smooth texture, many of which by actual trial, measure twelve inches in length and nine in breadth, and weigh a quarter of a pound avoirdupois a piece. Should this species of mulberry prove to be valuable, it will be a source of almost incalculable profit to the families of the south west. Already acclimated no danger need to be apprehended from the

* Letter from General Tallmadge.

† Du Pratt's Hist. of Louisiana, p. 187.

‡ Answer to the silk circular sent by secretary of the treasury, 1827.

§ But see a somewhat spirited article in the Silk Culturist, vol. ii. p. 158, col. 3 *et seq.* from the Mechanic's Messenger.

‖ Ib. vol. iii., p. 34, col. 1, *et seq.*

severity of our winters. Another species of mulberry which I have discovered, yields a beautiful leaf, eleven inches long, but which weighs only half as much as the rubra. It is a very fine and brilliant leaf with a lobe or ear on each side, about midway between its widest place, and its point, which gives it a peculiar appearance. The worm is voraciously fond of it, I think it to be a valuable kind especially for second crops."*

Species III. Broussonetia Papyrifera,† or *Japan paper mulberry*. The leaves are rough, either cordate, entire or lobed. The tree is of rapid growth and rises to a large size, with a round head. It is a native of China and Japan. From the inner bark of its branches, the Japanese make their paper; and also certain articles of clothing. Its leaves are also used as food for the silk worm, for which purpose the tree is now successfully cultivated in France.‡

* "From the character of the leaves and fruit of a *native* mulberry tree growing in Washita,* there is reason to believe that it is a different species from the *morus rubra*. The leaves are three-lobed, three-nerved, unequally serrated; base, subcordate entire; lobes, ovate oblong, acute or acuminate; sinuses broad, with large interjected acute teeth. Both surfaces rough. The leaves are larger than those of the red species. Upper lobes more ovate, with base narrower; no pubescence beneath: lateral lobes narrower than the middle teeth of the sinuses, sometimes entire, sometimes with a few unequal teeth on the side, upper sinuses broader than the lower."

† "Termed Broussonetia," says Count Dandolo, "from the name of M. Augustus Broussonet, a distinguished professor."

‡ "The bark of this tree not only furnishes fibres for ropes, but it can even be formed into a species of cloth. M. la Rouverie affirms, that he procured a beautiful vegetable silk from the young branches of this species of mulberry; cutting the bark while the tree was in sap, and then beating it with mallets and steeping it in water, he obtained a thread from the fibres, almost equal to silk in quality; and this was woven into a cloth whose texture appeared as if formed of that material. The women of Louisiana obtain a similar production from the off-shoots of the mulberry. These are gathered when they are about four or five feet high. The bark is stripped and dried in the sun. It is then beaten to get rid of the external part, which falls off, leaving the inner bark entire. This is again beaten, to make it still finer, after which it is bleached in dew. It is then spun, and various fabrics are made from it, such as webs and

* Sent by Judge Bry to the secretary of the treasury: Letter from the secretary of the treasury.

The Abbe Grozier speaks of this species, in his description of China, in the following manner, "This tree is so much more precious to the Chinese, because it furnishes them with a great quantity of paper which they consume. When its branches are broken, the bark detaches itself and peels off like long ribands. To judge of the species by the leaves, it would be thought to be a wild mulberry tree; but by its fruit, it resembles more a fig tree. It produces milk like the fig, if pulled before it ripens. Its resemblance to the fig and mulberry trees, may be the cause of its being regarded as a species of sycamore. It grows on mountains and stony places."

Species IV. and V. Morus Tinctoria, and the Morus Indica, which seem not to be generally known, are not used for the nourishment of the silk worm.

Species VI. Morus Tartarica, or *Tartarian mulberry*, abounds on the borders of the Sea of Azoph, and on the banks of the Volga, and of the Don or Tanaïs. The leaves are large, oval, oblong, serrated, and shining. The fruit resembles the *Morus Nigra*. The leaves afford silk of the finest quality.

It is proper that we should in this place state, that Count Dandolo, in the enumeration of his 12 species, mentions the Morus Constantinopolitana, as well as the *Morus Tartarica*. But he nowhere mentions the Morus Broussa. This circumstance, and the proximity of Constantinople to Broussa, warrant the presumption, until evidence to the contrary, that these two are the same. It has been asserted that the *Broussa* can be raised from its own seed; it is, therefore, a species; and whether this species may be considered or not the same as the *Morus Tartarica* or Tartarian mulberry, may be in some degree, determined from the note below.*

fringes; and sometimes it is woven into cloth. The finest sort of clothing among the inhabitants of Otaheite, and other of the South Sea Islands, is made of the bark of this tree."—Dr. Lardner.

* "The silks of Turkey have long been celebrated for their softness,

Species VII. Morus Alba, called the *White* or *Italian mulberry*. This species originally was from China, but has been most extensively cultivated in Italy and France for ages. The silk which it produces is of the finest quality. The leaves are cordate, serrate, entire or lobed. Their upper surface is a shining green, perfectly smooth, and the under has some hairs set on its edges. The flowers are monoecial; some males, disposed in cylindrical chatons, supported on peduncles, longer than themselves: the others, females, form round or oval chatons, rather short peduncles, which are succeeded by small berries of the same form, and of a red or white colour. The fruit is white, roundish oblong and *insipid*. It is a tree of a rapid growth. In the climate of Paris it attains to the height of 25 or 30 feet, but in more southern countries of 40 or 50 feet, with a trunk from 6 to 8 feet circumference.* This tree is known to have attained the

richness and brilliancy. This can only be accounted for, from the superior excellence of the *Turkish* mulberry," (*Tartarica, Constantinopolitana* or *Broussa?*) "Fortunately there are already trees growing in this country" (America) "*from the seeds of the Broussa mulberry*. Mr. Charles Rhind, some years American Consul at Odessa," (*where the Tartarica is indigenous,*) "struck with the beauty and the brilliancy of the Turkish silk, came to the conclusion, that it was attributable to the superior qualities of their mulberry leaves; and that he could not confer a greater benefit on his country, than in acquiring *the seed* of this species, and planting it here. From the local situation of Broussa, which is on elevated ground at the base of mount Olympus, whose tops are covered with perpetual snow, and from the hardiness of the mulberry trees growing there, he concluded that they were adapted to our climate, and would resist our severest winters. He obtained *a quantity of the Broussa seed*, and committed it to the care and cultivation of David Ruggles, Esq., of Newburgh on the Hudson River. Under the superintendence of Mr. Ruggles, *he has growing in his nursery, ten or twelve thousand trees* of about three years old. Mr. Ruggles asserts that these trees are very hardy, and that not one of the several thousands growing in his nursery, has been affected or killed by the frost of the two last severe winters."—The Cultivator, vol. iv. p. 14.

"I wish, however, to be understood that by *Broussa*, I do not mean all those *various kinds*, which are sold under that name, but I have a direct reference to the tree or trees which Mr. Charles Rhind brought from Broussa to this country."—Letter of Mr. C. F. Durant to the Secretary of the American Institute, February, 1838.

* The bark, according to Rosier, may be converted into linen of the

venerable age of more than 400 years. Its superiority over every other mulberry, except the morus multicaulis, consists in this; it is clothed with leaves fifteen or twenty days earlier than the other; the silk worms, therefore, come more speedily at maturity, and are thus preserved from the inconvenience of the hot season. The white Italian mulberry, moreover, not only grows more rapidly, but has a more abundant foliage; and leaves more delicate and nutritious, whence the silk is more handsome, and of a better quality.

The forms of the leaves are extremely variable. M. Audibert,* an experienced cultivator in France, says, "that the same tree will have leaves divided into several lobes, when young, and when it becomes old, they will be entire; others have the second crop of leaves differently formed from the first; some again have entire leaves in the spring, and lobed leaves in autumn. Hence the difficulty that not unfrequently occurs on this and other accounts, of stating what are distinct species, and what are merely varieties.

Of this tree it is generally confessed indeed, that there are, even when raised from seed several varieties; many of which are of inferior quality, the trees being thorny, the leaves small and few in number. Hence Count Dandolo sought improvement by engrafting or inoculation with the large leaved kinds. He particularly mentions those known in Lombardy, by the names, *folia doppia*, and *folia giazzolia*. M. Bourgeois and M. Thome recommend those grafted with the *rose-leaved* and *Spanish mulberry*.

The Count says, "the common grafted mulberry comprises the following varieties: 1. *Of a white berry:* 2. *Of a red berry:* 3. *Of a black berry:* 4. Of a large leaf called *of Tuscany:* 5. Of a middle

fineness of silk. For this purpose, the young wood is gathered in autumn, during the ascent of the second sap, and immersed for three or four days in water. It is then taken out at sunset, spread on grass, and returned to the water at sunrise, and this is daily repeated, until finally it is prepared and spun like flax.

* Essai sur des muriers, et des vers-a-soie, par M. Deslongchamps, p. 21. Paris, 1824.

sized leaf, dark green, called in Italy, *folia giazzola:* 6. Small leaf, of a dark colour rather thick called double leaf, more difficult to pick, but the best calculated for the nutrition of the silk worm."

M. Morin, who paid particular attention to the mulberry, informs us, that "the careful culture of the *white* mulberry has produced many varieties, distinguishable into the *wild* and *grafted.* The first comprises four sub-varieties; the first called FEUILLE ROSE, *rose leaf,* bears a small white insipid fruit, and its leaf is rounded like the small leaf of a rose-bush, but larger: the second, LA FEUILLE DOREE, *the gold leaf,* has a small purple fruit, and an elongated shining leaf: the third, LA REINE BATARDE, or *bastard queen,* is distinguished by its black fruit, and its leaves, which are twice as large as the rose leafed, indented in their circumference, at the superior extremely elongated to a point: the fourth is called, FEMELLE, the tree is thorny, it puts forth flowers before leaves, which are divided into three lobes like clover.

In the grafted mulberry we distinguish also four varieties; 1. LA REINE, *the queen,* with leaves shining and larger than any of the wild; its fruit is ash-coloured: 2. LA GROSSE REINE, *large queen,* has leaves of a deep green, and a black fruit: 3. LA FEUILLE D'ESPAGNE, *the Spanish leaf,* bears very large leaves, extremely rough and thick, and a long white berry: and 4. LA FEUILLE DE FLOCS, *the woolly leafed,* is of a deep green, very like the former, but less elongated and disposed in tufts on the boughs. Its fruit very abundant, but never comes to maturity.

However, as it is very difficult to distinguish the wild mulberry, as the morus alba grow nowhere in Europe spontaneously, but we meet with them always cultivated; and the young plants that grow in the nurseries cannot be considered as wild specimens, since they come from seed obtained from trees, that a long culture has more or less modified, and that they have themselves sometimes undergone new

changes by the effects of a change of climate and peculiar treatment in the culture; therefore it is, that *in even the trees of a distinct species raised from seed we observe differences more or less considerable in the* thickness or size of the leaf or in the habit of remaining entire, or dividing into lobes. And if these young trees were not grafted before bearing fruit, we should find in them differences which might serve to distinguish them; but, otherwise, they must create new varieties from each particular seed.

The only varieties of which it will be useful to mention are those which, being propagated for a longer or shorter time from the seed, have been distinguished as exhibiting remarkable characters or qualities, and which, therefore, pains have been taken to multiply by cuttings or by grafting on seeding plants in the nursery which are called wild stock. Such are the following:

1. Morus alba rosea, *rose leafed mulberry.* The tree is slender, with branches more extended than all the other grafted varieties. It may, however, attain a great height. Its wood is more solid and compact. Its leaves are shining as if varnished, rarely lobed, borne on rose petioles; and its fruit is of a rose gray.

2. Morus alba ovalifolia, *oval leafed white mulberry*, or *Roman mulberry.* The tree is large, and grows rapidly. Its leaves are large and handsome, shining on the upper surface; whole and sometimes divided into three or five lobes on the young and vigorous stems. Its berries are rose gray or lilac. This variety is most prevalent in Provence, or in the environs of Avignon or Languedoc. It is agreed that the rose leafed variety produces a leaf of superior quality, which gives a good silk, and occasions not those diseases to the worms which arise from leaves too moist, or from a soil too fertile.

3. Morus alba macrophylla, *the grosse reine white mulberry.* This variety grows large, but not higher than the Roman. Its shoots are large, and its

buds nearer together. No other variety exhibits so large leaves. They are a little more plaited, and their petiole is short. The berries are large and white, very sugary, without, however, the agreeable acidity of the berries of the black species. A smaller quantity of this variety is planted, and its leaves are only given towards the end of the feeding season, or when the worms are on the eve of moulting.

4. Morus alba oblongifolia, or langue de bœuf, or *ox tongue mulberry*. Leaves large, shining, not lobed; nearly twice as long as broad. This variety is cultivated in the Cevennes; but it is not much esteemed. They prefer that called *colombassette*, which seems to be a sub-variety of the rose leafed mulberry of Provence.

5. Morus alba nana, the dwarf white mulberry. This tree is a little larger than that known under the name of *Constantinople mulberry*. Its leaves are like those of the *grosse reine*, but its berries are white.

The dwarf mulberry may be advantageously cultivated, since its boughs are near; and this tree of small size will furnish as many leaves as another thrice its magnitude; and a greater number can be planted on the same space of land.

6. Morus alba integrifolia. A mulberry with leaves always whole and shining.

7. Morus alba integrifolia obscura. Leaves always whole but not shining.

8. Morus alba semilobata, with large leaves, tough as leather; divided into from two to five lobes.

9. Morus alba lobata. Leaves divided as far as the centre into from three to five lobes. This mulberry has three sub-varieties, viz. of very large, middling or very small leaves.

10. Morus alba laciniata. This variety has its leaves divided into five deep lobes; of which the middle one, larger than all the others, is itself divided into five or six alternate lobes. To these varieties may be added another cultivated now for some years past in the Jardin du Roi, and brought from the Isle

of Bourbon, by Captain Philibert. Its leaves are whole and scarcely marked, nearly dull on the upper surface, more decidedly pubescent on the lower than other white mulberries. Its parenchyme or pitch is rather small and dry. It withstands the rigour of the winter even when unprotected by the cultivator.

M. Loiseleur Deslongchamps has pointed out still further varieties of the white mulberry, interesting on account of the qualities they possess for the nourishment of the silk worm.

"The *first* is LA COLOMBASSETTE. This is the most ancient known variety; its leaf is small, slender, thin, very soft; the silk worms prefer it to other kinds. The berries at maturity are yellowish and very large. The trees are the largest of the species, and of the longest duration.

"The *second* is LA ROSE. Its leaf is a little larger, and of rather deeper green than the colombassette. It is as good for the nourishment of the worms. Its berries are reddish, and of the same size as those of the preceding variety.

"The *third* is LA COLOMBASSE VERTE, exhibiting two sub-varieties, which are designated by the names of the large and the small colombasse verte. Its leaves are not so fine as the two first, but they are larger and more elongated. Its berries are bluish, and not so large as those of the *colombassette* and *la rose.*

"The *fourth* is LA RABALAYRE, or TRAINEUSE; a variety much resembling the *colombasse verte:* but which is essentially distinguished from it, in its buds being further apart, and of consequence the tree produces less leaves; but as it is less exhausted by the production of foliage, it grows large and developes itself rapidly. The tree bears few berries; which are of the same colour as those of the *colombasse verte.*

The *fifth,* LA POUMAOU, or LA POMME. Its leaf is large, rather fine, and of a round form. The tree produces scarcely any berries, and though it does not throw out shoots as long as the other varieties, it fur-

nishes a sufficiently large quantity of leaves, because its branches are leaved in their whole extent.

"The *sixth*, LA MEYNE. This variety has the greatest resemblance to the preceding, both in quality and size. The form of the leaf is not so round.

"The *seventh*, L'AMELLA, or L'AMANDE. The leaf of this variety is oval, much thicker and heavier than that of all the preceding, and more difficult to gather. It suffers less than those from the cold, or from winds and dew which produce mildew or mould; a disease of the leaf that is productive of loss. The tree yields very few berries.

"The *eighth* is LA FORCADE, or LA FOURCHE; a variety, whose leaf is nearly round, and very abundant, on account of the proximity of its buds.

"The *ninth* is LA DURE. It bears this name, because its leaves are really hard, not for the worms, but in detaching them from the branches. It requires strong arms to gather them; and labourers to make the work lighter, detach them singly. Its leaves are nearly round, rather fine, and are produced as abundantly as those of the fourcade. It produces no berries.

"The *tenth* is L'ADMIRABLE. This *variety* exceeds all the others in the size of its leaves, which are strong and thick, and, by reason of the nearness of the buds, produces them in greater abundance. They, generally, are not given till after the fourth moulting, because the worms then have the requisite strength and appetite to eat them without injury. When this tree is set deeply and well cultivated, its leaves attain an extraordinary size. It is not then uncommon to find them even eleven inches long by nine broad. The berries are few, small, and grayish."

Of these ten varieties the *colombasse*, and the *colombassette*, are most favourable to the health of the worm, and to improvement in silk, both as it respects quantity and quality. Notwithstanding, in France, the preference, generally, is given to the *poumaou*, the *meyne*, the *fourcade*, *l'amella* and *l'admirable*, on account of the abundance of leaves they produce.

The above are *varieties* of the *white mulberry;* and it is evident from what has been said, that varieties of this, and of the other species, may, by artificial culture and other means, be tortured to an almost indefinite extent. But with regard to what are the several *species* of the GENUS mulberry, we have already observed that, authors differ; and, perhaps, will do, until we can find combined in one, the character of the accurate botanist, and that of the practical horticulturist, whose skill is the result of long-continued and patient observation. Count Dandolo has enumerated no less than twelve kinds as species. Eminent, no doubt, he justly is; but then it is chiefly for the accurate development of his valuable experience relative to the wants, habits, and economy of the silk worm, but not as a phytologist. The following, however, is his enumeration of species.

"1. *Morus alba.* 2. *M. tartaria.* 3. *M. Constantinopolitana.* 4. *M. nigra,* (the common mulberry well known; its fruit of a sweet flavour. Particularly cultivated in the ex-Venetian provinces.) 5. *M. rubra,* (cultivated in botanical gardens.) 6. *M. indica,* (also cultivated for botanical purposes.) 7. *M. latifolio,* cultivated in botanical hot-houses. 8. *M. australis.* 9. *M. mauritiana,* (these three latter sort are little known in Italy.) 10. *M. tinctoria.* 11. *M. papyrifera.* (These two last have been recently transported into another class of plants, termed *M. Broussonetia.*) The list I have given sufficiently shows the variety of mulberry leaves which might be found even more suitable to the nourishment of the silk worm, than those hitherto used."

With the exception of the enumeration of a few of the varieties of the white mulberry, the above is all the information we shall derive from Count Dandolo's work "*on the Art of rearing Silk Worms,*" relative to what kinds are distinct species of the mulberry; though as to the subject on which it professedly treats, we shall find the most ample satisfaction. But how

very different is this from the enumeration of species given in Loudon's "Encyclopædia of Plants;" than which, both as a botanical work, and a recent production, no other Treatise stands equally and more justly eminent.* In this work the kinds ranked as species are only five, viz.

Class, Monoecea; *Order*, Tetrandria; *Genus*, Morus.

Species I. Alba; white; China; leaves deeply cordate, unequal at the base, ovate, lobed, unequally serrated, smoothish.

Species II. Tartarica; Tartarian; Tartary; leaves slightly cordate, equal at the base, ovate or lobed, equally serrated, smooth.†

Species III. Nigra; black or common; Italy; leaves cordate, ovate or lobed, unequally toothed, scabrous.‡

Species IV. Rubra; red; North America; leaves cordate, ovate, acuminate or three-lobed, equally serrated, scabrous, soft beneath. Fem., spikes cylindrical.†

Species V. Tinctoria; fusticwood; West Indies; leaves oblong, unequal at the base; spines axillary, solitary.§

* "Encyclopædia of Plants," by J. C. Loudon, F.L.S. H.S., &c. and others, London, 1836, 8vo. pp. 1160, price £3 13*s.* 6*d.* In the production of this volume more botanical works have been consulted than most men can have access to in a century.

† "Morus rubra has black shoots, rougher leaves than the black mulberry, and a dark reddish fruit, longer than the common sort, and of a very pleasant taste. The tree is cultivated in China, but not so generally as the white mulberry. Morus tartarica bears pale red berries of an insipid taste, but eaten in Russia fresh, conserved or dried."

‡ "Young trees, like most of the monoecious class, often produce only male blossoms for many years after they are planted, and yet afterwards become fruitful. As the tree increases in age, it increases in fruitfulness. In some of the old gardens near London, there are black mulberry trees, of a great age, which are very healthy and fruitful; most of which were planted in the time of James I."

§ "Morus tinctoria is a tall branching tree, with a fine head, smooth leaves, and awl-shaped solitary spines. The whole plant abounds in a

Notwithstanding these authorities, we find, in a recent publication, the following noticed, not as a *variety*, but as a *species*, viz.

"DANDOLO, OR MORETTIANNA MULBERRY, is a new and most valuable SPECIES of mulberry for the nourishment of the silk worm. It was first discovered about 1815, by M. Moretti, professor in the University of Pavia. The tree is presumed to be hardy; the fruit which is at first violet, becomes at maturity perfectly black. The leaf is ovate, sharp pointed, entire, cordate at the base. It is thin, smooth on the under and especially on the upper surface; which is of a beautiful and rather deep shining green. It is not near so thick as that of the large white mulberry, called in France the *admirable:* and is thinner than that of the *Spanish mulberry* or *morus nigra.* It is neither wrinkled nor plaited. Generally, the leaf is nearly eight inches wide, and ten inches long. This mulberry will be most profitably cultivated in the form of a hedge, and from the superior size of the leaf, its foliage is gathered with facility. Its superior quality has been proved by the experiments of M. Gera, and Count Dandolo, who assert that it produces silk of a more beautiful gloss, and finer quality than common silk.*

The following, however, by the somewhat indeterminate language and method of the same author is acknowledged to be a *variety.*

"MORUS LUCIDA, or *shining leaved.* The leaves

slightly glutinous milk of a sulphureous colour. The timber is yellow, and a good deal used in dyeing, for which it is imported under the name of fusticwood."

"*All the species of morus are remarkable for putting out their leaves late; so that when they appear, gardeners may safely set out their greenhouse plants, taking it for granted, that all danger from frost is over.*"—Loudon's Encycl. of Plants, p. 783.

* See the whole article inserted by the Hon. H. A. S. Dearborn, in the New England Farmer, vol. viii. No. 29. It is from the Annales d'Horticulture; and it is extracted from the report of Dr. Fontaneilles, on a letter published by M. Gera in 1826, in the Journal of Physics and of Chemistry of Pavia.

are very large, pointed, cordate and shining. This VARIETY is said to be highly deserving of cultivation for the nourishment of silk worms."

CHAPTER II.

ON THE CULTURE OF SPECIES, OR OF KINDS CAPABLE OF REPRODUCTION FROM SEED.

CLIMATE, SOIL, SITUATION, SEED, SEEDLINGS, NURSERIES, ENGRAFTING, &c. TRANSPLANTING, STANDARDS, PLANTATIONS, INSTRUMENTS.

THE question of CLIMATE refers at once not only to the mulberry, but also to the silk worm; for the former would cease to be an interesting object of cultivation, could it be found in a region where it might be *satisfactorily* proved that the latter, *at least with such adventitious means as peculiar circumstances might require*, could not exist, or perform, with success, functions so important to the conveniences of man. Both the one and the other, as the question refers to latitude, have been found in a prosperous condition, in all parallels from the equator to that of fifty-four degrees in Russia, and of fifty-five degrees in Sweden. But how far the influence of moisture held in solution, within topical limits, in the atmosphere, may be corrected, is a question that remains yet to be proved, by that peculiar kind of cocoonery, which hereafter, for distinction sake, we shall call the *Dandoliere*, which is useful chiefly in countries where humidity is prevalent.*

* "The silk worm is by no means so delicate as many may imagine. Mr. Cobb saw the insects raised by M. d'Homergue in a yard of mulberry trees in Philadelphia, which endured cold windy days, and storms of rain and thunder; and notwithstanding spun in thirty days. At Northampton, also, the eggs of the silk worm, which had been deposited

In the recommendation of SOIL proper for the culture of the mulberry, there has, amongst authors, been some discrepancy. Although it is to be conceded that this invaluable plant will flourish in a *moist* and *rich* soil, and even, of course, more luxuriantly when thus favoured than it otherwise would, yet experience has proved that not only the leaves thus produced are not so suitable to the health of the worms, but that the vegetative function is thus protracted too late in the autumn to allow the young wood to ripen sufficiently to withstand the attacks of early frost. The majority of authors, therefore, and amongst them the most experienced, agree that the soil should be *dry*, *sandy* loam, or *stony*. It has been even said, though perhaps the opposite extreme, "the more stony the better, provided that the roots can penetrate." Of stiffer soils, a *calcareous sandy clay* is to be preferred. But clay that is heavy, and earth that is fenny or marshy, and on which through excess of moisture, the frost has greater power in winter, not only expose young trees to greater danger before their coating is formed and wood matured, but also favour the growth of moss on the bark, and of leaves too full of moisture to suit the health of the worm. In this country, it is admitted as a general rule, that all soils adapted to the culture of Indian corn, or that will produce ten bushels and more to the acre, are adapted to the culture of the mulberry.

As to SITUATION OR SHELTER, all agree, that nurseries and plantations should have a *sunny exposure*, and protection against strong cold winds. *Declivities*, *hill sides*, *land sloping* towards the east, south-east

on the outside of a window frame, remained uninjured and hatched well, although they had endured alternate sunshine and cold winds and storms, and the extreme rigours of the last uncommon winter, and a degree of cold thirty-three degrees below zero. There too stood the common white mulberry, and the multicaulis; the plants of three years growth. A shelter, however, is necessary for the silk worm, to defend it at once from long and fatal storms, and from insects and birds of prey."—Kenrick. See on the subject of Climate, the History of Silk in this volume, as it refers to China.

or south, and protected on the north and north-west, by woods, groves, artificial plantations, or buildings, are situations eligible to favour and sustain the growth of the mulberry.

As to the PREPARATION OF THE GROUND if for standard trees, let it be manured in the cavity dug for the tree, but if for hedge rows, in the drill, with a compost made of one-eighth lime, three-eighths mould or decomposed leaves, one-fourth stable manure half rotted, and the remaining fourth of leached ashes, prepared and suffered previously to mellow for three or four months, during which it should be three or four times turned up and mixed with any well rotted manure. The ground itself should be prepared, if for hedge rows, by previous ploughing in the autumn, and once again on the opening of spring. The reader will recollect that we now treat of the white, &c. mulberry, as the varieties require different culture. But if IT IS TO BE PREPARED FOR A SEED BED; manure it well with a compost made of stable manure, ashes, decomposed leaves, of each one-third, or instead with any well rotted manure. Let the soil be dug deeply, finely pulverized, and laid off in drills twelve inches apart, and half an inch deep.

To OBTAIN THE SEED. As fast as the fruit ripens, it should be gathered, otherwise it will fall from the tree and be lost, or devoured by birds. When a portion of the fruit is ripe, spread blankets under the trees, and shake them gently every morning during the ripening season. By this means the ripe berries are disengaged from the boughs, and falling on the blankets, are easily gathered, whilst those that are unripe remain undisturbed.

To PREPARE THE SEED.* To avoid fermentation,

* To save the seed of the white mulberry, M. de Labegaire gives the following directions. "Gather the berries as they fall from the tree; put them for two days in a dry place, where they must be turned up and down for fear they should be heated; after which mash them with your hands in a tub, pouring over them some water from time to time in order to separate the seed from the must. Let then the water settle for a quarter of an hour, and all the useless particles floating over will

suffer not the seed to remain in the fruit longer than three days; but put it into any convenient vessel, and mash the fruit with the hand, into a pulp. On this mass, having poured water, stir it briskly till a complete separation takes place between the seed and the pulp. During the process, frequently decant the water from off the sediment, and with it suffer all super-natant seed to flow off, as not good. Rub the last sediment through a sieve with meshes of sufficient size to admit the passage of the seed, which should be then laid on bibulous paper, or spread thinly on cloths and dried in the shade. Put it finally in bottles, when well dried, and by corking well, by situation and other means, exclude the *light*, *air*, and *dampness*. The white mulberry seed is of an obtuse triangular shape; and of a dark, dull, yellow colour, and full of oil. The fruit of the white mulberry, when ripe, if put in the ground whole, will vegetate immediately, and if the plant be kept weeded, will be sufficiently advanced, with the aid of a slight covering, to stand the winter. The first fruit of this tree ripens about June. It may be sowed on well pulverized ground and covered with a fine toothed rake. As to *the preparation of seed*, so far as it refers to immediate sowing, be it remembered that there are authors who recommend *previous soaking*, some in *cold*, others in *warm*, some in *hot*, others in *boiling water!!* and a few in *oxymuriatic acid*, or in a *solution* of the chlorate of potassa, for a time varying according to the creed of the several experimentalists, from six to *forty-eight hours!* All this, at best, in the present state of this *soaking theory*, or without further limitation, is indefinite and venturesome. It may be very well, on the small scale, as to some limited crop, or as a matter of experiment. But should this time for

be taken out. Repeat the washings till the seed is disengaged and pure. The best seed being the heaviest, will stay at the bottom of the tub. Then spread the seed to dry upon a piece of linen, and when dry it must be put by till the season for sowing,"—which should be about the 1st of May.

soaking, particularly as it refers to any large crop, be protracted, which it may especially in the hurry of the spring season, by the labourers being prevented by other pressing duties, from sowing the soaked seed until after the germinative vigour of the seed is exhausted by this precocious and ill-timed process, the whole crop, whether it be of one or twenty acres, will be unquestionably lost.* As to the term *hot*† water, it is grossly ambiguous, and the term *boiling* not less questionable, however recommended. On the whole it would be safer, especially to avoid the possibility of previous accident and delay, *instead of antecedent soaking*, to water, from the common gardening pot, after the dry seed is in the ground, the beds, with a *very mild*‡ solution of the carbonate of potassa. This was never yet tried but with success. The Chinese books say, "when the time for sowing is come, the seed must be mixed with some ashes from the burnt branches of the mulberry trees, and they must be soaked to make them soft. The next day the seed must be washed with care, and those that float rejected. The full seed must be dried in the sun until the absorbed water has entirely evaporated. They can then be sown, and they never fail to grow rapidly." *Nong-sang-thong-kioué.* Here is, however, no mention of hot or boiling water.

Mode of testing the quality of seed.—This is a point, in this age of studied selfishness and designed deceit, far from being unimportant, especially when the seed of certain vegetables may, so far as appear-

* In this way precisely, a farmer lately, within ten miles of Philadelphia, lost the valuable crops of ten acres, on which he relied for the payment of his rent. He depended on this soaking theory, and it rendered him insolvent.

† "In a solution of soot and *hot* water for forty-eight hours," says a publication of 1838.

‡ Two ounces dissolved in three gallons; and the watering repeated, if the season be dry. The water generally, in all natural cases, is agent sufficient without any thing adventitious. But a *weak* alkaline solution, or even water with common soap-suds will not injure. On the contrary, the result has frequently been a luxuriant crop.

ance goes, be easily substituted, and sold at a high price, to any one not a connoisseur, for that of the mulberry. Seed bought at the shops may not only be spurious, productive merely of hybrids, but also old, and, therefore, liable to protract the germinating process, until neutralized or destroyed by the frost. In order to guard against imposition, seed of domestic growth should be preferred when it can be obtained, or procured at least from those on whose veracity we can depend.* Such seed, or that on the quality of which we can rely, may be safely, at the proper season, committed to the ground; in it, as well as in the best sample, there may be some unproductive seeds, which the common vegetative process will in the natural way indicate. A recent writer says: "Soak the seed in *hot* water a *few* hours, when the seed that is worthless will float," without having the politeness to tell us, *how hot.* This gentleman, no doubt, is fond of a *hot* potato, but we could readily obtain him one, which if it once reached his mouth, he would be glad to drop it soon, as a bad concern.† "It is computed," says a writer in the first volume of Fessenden's Silk Manual, that one ounce of seed properly sown will give about 5000 young trees." Another writer allows about 8000 trees to the ounce, and from the average of these two, we may infer 100,000 trees to the pound of seed avoirdupois. This is confirmed by what Mr. Comstock says, viz: "From a single pound of seed, one hundred thousand plants may be reasonably expected." There are in one pound avoirdupois, of white mulberry seed, about 322,700 seeds.‡ This therefore allows one seed

* Turnip, poppy and other seeds, have been sold in the "*down east*," for the genuine multicaulis seed; first at $5 an ounce, then at the same price for a small paper containing 2000 seeds, not worth one cent.

† "Before sowing," says Judge Comstock, "the seed ought to be steeped in water about *blood warm*, for 24 or 36 hours." Now this is definite; and if the seed be sown immediately after, the above objection will not apply; but we should think 24 hours to be amply sufficient.

‡ According to an actual trial, made this day, 9th February, 1839.

nearly out of every three to vegetate. On this subject, Count de Hazzi, says: "From 9,600 to 10,000 seeds weigh about one ounce of our Bavarian weight, and 320,000, or at least 300,000 seeds may on the average be considered to the pound."

TIME OF SOWING. *From the first of April, to the beginning of May*, or even in favourable situations, should circumstances require it, *so late as the beginning of June.* But it should be remembered, that the earlier the spring sowing, the more strength, firmness and bark the seedling will acquire to resist the attacks of its first winter, which will be the most critical period in the history of the young plant. Autumnal sowing for no species of mulberry can be fully recommended. But if peculiar circumstances should render it desirable when it could not be attended to in the previous spring, it may be attempted with partial safety, not later than *the first week of August,** provided that every facility, by manuring, pulverizing, weeding, and subsequent culture, by covering the young plants with horse manure, straw or refuse hay on the approach of winter, be afforded to the beds intended for its reception.

MANNER OF SOWING. The seed may be sown in seed beds or nurseries, as best suits the convenience of the cultivator. When land is no object, it will be best to sow them in the nursery, as it will save the labour of once transplanting. For spring sowing the land should be prepared by ploughing, &c., the preceding fall. Every cultivator knows the fertilizing effects of frost and snow, and consequently ought to avail himself of them at the proper season.† The ground should also be ploughed again, or two or three times if necessary to render it light and friable, in the

White mulberry seed has been selling in New England at various prices for some years past from $4 00 to even $7 50 per lb.

* A quantity of seed thus treated in Philadelphia lived through the cold winter of 1825-6.

† Dig or plough the preceding autumn, and leave the ground rough, and exposed to the pulverizing action of frost and thaw all winter.

spring. Two or three dressings of manure well ploughed in, will be of essential service. The seed may be sown in drills, *at sufficient distances asunder to admit of passing between them*,* for the purpose of weeding and hoeing. Roll the seed in plaster of Paris, or mix with mould, then sow it tolerably thick, as in the sowing of onions or carrots. For a single ounce of seed, a bed fifty feet long and four broad, prepared by manuring and culture, as already described, will be sufficient. With the rake cover the seed not more than half an inch in depth with rich mould, and immediately press, or lightly tread, or roll down the mould to cause the seed to come into contact with the earth; and over the whole may be laid some horse manure.

Subsequent culture of the seed beds and seedlings. Should the weather be dry, water the seed beds every other evening. The ground must be stirred occasionally, or the soil lightened between the drills, and the beds at all times kept clean of weeds. With barn-yard drain, or soap-suds, continue to water once, in dry weather twice, a week, and in every case either before the rising or after the setting of the sun. It is important to push, by every means, the growth of the young plants sown in spring, in order that the stronger ones, at least, may be transplanted into nursery beds on the ensuing spring. The watering should not be carried on after August.

"I have sown the mulberries in July," says Mr. Cobb, "and they have sprouted, and come on rapidly; but the frosts of winter, in our climate, (New England,) have been too severe for them. I would recommend to sow the seed in the spring. From a quarter of an acre of ground, the last season, I had over 10,000 plants, produced from seed sown in the spring, in the way above mentioned," (equivalent to 40,000 per acre,) "some of them upwards of a foot in height."

* From one to two feet distant.

On the near approach of winter, or on the first appearance of what is commonly called black frost, cover the plant beds with long stable manure, leaves, straw, or matting, and confine the covering with twigs of pine or evergreen, until the middle of the ensuing April. Even then, the covering is to be removed only with caution, lest the young plants should be exposed too suddenly to sudden returns of frost or bleak winds before a more mature growth and the further advance of spring render them secure. Care must be taken, in covering the plants, not to oppress or smother them.

Transplanting does not appear always to take place so early in France as with us; nevertheless part of their practice seems worthy of our attention. "The plants will soon show themselves, when they must be thinned, if growing too thick, putting them, as near as possible, two or three inches apart. After having let them come to the size of a goose quill, it will be necessary, for at least three years, counting that in which they are sown, to tend them during the whole time in the following manner. At their first appearance they should be thinned: the second year they are to be pruned of all the small branches up to a foot from the ground; from time to time they must be watered; they should also be weeded with a weeding hook, have frequent tillage; be retrenched of all the superfluous branches, and all that are unthrifty, poor, or grubby must be entirely cut off. The *best* only are to be *grafted*, after having transplanted them to another place, dug about and tilled anew, and set at the distance of at least three feet from one another."*

Sowing by the whole fruit. We cannot omit to mention that Mr. W. H. Vernon of Rhode Island has, through the medium of his translation, published at Boston in 1828, of M. de la Brousse's Treatise on the Cultivation of the Mulberry Tree, and on the

* Morin.

raising of Silk Worms, favoured us with the following account of the French mode of *sowing by the whole fruit*, or berry, instead of by the *dried seed.* "On two acres of land, or on any other quantity, at the will of the proprietor, *beds must be made four feet wide*, levelled and smoothed with the rake. On these beds must be traced by a line eight small furrows lengthwise, *two inches wide*, *and very little more than half an inch deep*, and at the *distance of six inches from one furrow to another.* At this moment it is necessary to be provided with mulberries, (i. e. the fruit,) from the white mulberry tree or else from the Spanish, which are the two most proper kinds for this purpose; they must then be dropped in the furrows, at the *distance of twelve inches* from each other, must be covered from the sides of the furrows, and the beds carefully levelled with a short toothed rake."

"There are TWO SEASONS for making nurseries, *the spring*, and the *time of the maturity of the fruit.* Those who choose to sow the *seed* of the mulberry in the *month of April*, must consequently use the *dried seed gathered nine months before*, and less apt to sprout. But those who *sow the fruit* at its maturity, enveloped with all its moisture, (or pulp,) which seems intended for its nourishment, and to give it, if we may use the expression, *its first milk*, have generally the pleasure of seeing it put forth with vigour. Besides the heat of the season, provided the proprietor use the precaution to water the plants, will necessarily cause their rapid growth."

SOWING BROAD-CAST. This method is extensively and usefully practised in China; and has also been tried with success and profit in New England. Though culturists generally prefer the crops of standard trees or hedges, and the recent introduction of the multicaulis may render this process less necessary, yet occasions may exist wherein for special purposes it may be expedient.

On ground previously prepared sow the seed, broad-

cast, every spring; and the next year, when the young plants are covered with foliage, they may be mowed in the same manner that farmers mow small shrubs, and given to the worms. These mowings may be repeated until the stock becomes exhausted, when the land must be seeded again. During one season the same seedlings will bear to be mown thrice, and on different portions of the ground, the mowing may be daily continued according to the demand for the crop, except after very dry weather.

The advantages of this method are, 1. The leaves are gathered with little expense or labour. 2. The same area of ground will produce more foliage. 3. The making of silk may thus be commenced on the first year. 4. Tenants, as well as owners, from year to year, can secure a yearly crop of silk; and the quantity can be increased or diminished as occasion requires.

TRANSPLANTING. On this subject, authors do not precisely agree, and are generally wanting in that method which will be found necessary in this place. For the sake of distinction, we shall divide this section into what refers—1. *To the seed bed;* 2. *To the nursery;* 3. *To the hedge;* 4. *To the dwarf orchard;* 5. *To the hedge plantation;* and 6. *To the plantation for standards.*

1. By THE SEED BED we mean that on which not only the *young seedlings** or plants from seeds, are growing, but where they have suffered no transplanting, nor other disturbance, except that of being kept clear from weeds, and of the culture, already described, subsequent to sowing. From the seed bed, according to the time and manner hereafter to be stated, the seedlings are to be transplanted either to the nursery, the hedge, the dwarf orchard, or to the plantation for standards, according to the design and intention of the culturist.

* The term seedling will in this work be applied to young trees raised from seed, and not transplanted; and that for any age not exceeding three years.

Seedlings are fit for transplanting when they attain the height of eighteen inches; and generally on the second year, those not removed before, may be transplanted in the nursery. When the seedlings are taken up it should be with such care as to prevent injury to the roots. After this, it would be an advantage to assort them into classes,* planting those nearly of a size together. But, if they are thrifty, they may remain in the seed bed until planted out into hedges. It is, however, indispensable, when the seedlings are intended for standard trees, to remove them to a nursery, where they may more rapidly attain a larger growth than they would in the seed bed; and from thence they should not be removed to be placed out permanently for standards until they are one inch in diameter, and from four to eight feet, according to the French, or from seven to eight feet high, according to the practice with us.

2. By THE NURSERY we intend ground purposely prepared and reserved for the reception and growth of young plants, into which the young seedlings, at the proper time, are to be transplanted,† and there to remain, at proper distances, during the second period of their existence.

Horticulturists recommend a rich soil for the nursery; the ground at least should be previously prepared, as for any other crop. In *April*, or later, if there be a probability of the return of frost, parallel furrows are to be made of sufficient depth, *eight feet* asunder. In which, as soon as possible after removing from the seed bed, and taking away the ragged roots, as well as shortening the tap root, in order to force out lateral roots, the seedlings must be planted, *one foot apart* in the rows. Particular attention must be given to preserve all the small branches of the roots from contact as much as possible. The earth is then to be well trodden around the plant. Afterwards

* Two classes: Count Hazzi.

† In France, they transplant just after the fall of the leaf.

keep the soil open, free from weeds, and water in dry seasons.

When the plants in the nursery are sprung, strip off the side buds, and leave none but such as are necessary to form the head of the tree. The buds which are left, should be opposite to one another. If the plants in the nursery do not shoot well the first year, in the month of March following cut them over, about seven inches from the ground; this will make them grow rapidly. They should also be watered with diluted barn-yard water.*

3. MULBERRY HEDGE. One method of turning into direct profit, and economizing the very ground on which our fences stand, is to turn them into mulberry hedges. "The white mulberry," says Mr. Cobb, "forms an excellent live fence, and when once established, is probably the most permanent of any other. Cattle must not be allowed free access to the hedge while young, as they would destroy it altogether; but after it has become a good fence, they may approach it with advantage. The more it is broken and lacerated by cattle, the more impenetrable it will become; as for every branch broken, a half dozen shoots will immediately start out, till the bush forms a perfect bramble." This mode is, therefore, recommended as accomplishing three important objects: supplying food for silk worms; keeping the trees low, that the

* Several of the manipulations recommended by Count de Hazzi, on this subject, are worthy of attention. "The roots of a plant of one year being yet delicate, it will be better to put them in the ground with a planting stick, along a line, than with a shovel. They should be planted a little deeper than they were before; for a mould recently stirred sinks somewhat, and the seedlings would, therefore, be too high above ground. *They should be watered as soon as transplanted, in order to bring the earth into closer contact with the root.* These beds must be managed, during the summer, like the seed beds, viz. they must be cleared of weeds, and watered in dry weather; and, before the winter comes on, they must be covered again with dry leaves, several inches in depth, which are to be removed in the spring. Before the seedlings begin to bud, all the wood affected by the frost must be cut off, and the ground ought to be carefully opened and stirred, without injuring the roots of the seedlings."

leaves may be gathered from the ground by children; and furnishing a good and almost never ending fence.

Take seedlings two years old from the seed bed, and set them, *in the spring*, at the distance of *eighteen inches apart*, or, if it is intended to make a thick set hedge, at the distance of *one foot*. Cut off the tops at four or six inches from the ground, leaving two buds on each plant, opposite each other, and removing all the rest. This causes the stock to have two vigorous branches the first year. The next spring, cut off one of these two branches on the same side, at about twelve inches from the ground, in such a manner that each plant may have a long and a short one. Cut horizontally on the same side, also one after another, all the branches, and fasten them with cords or withes, so that they form lines parallel with the earth, and leave the entire branches untouched. At the commencement of the third year, the plants will have branches to form a hedge. The height, form, &c. of which may be regulated according to the fancy of the cultivator, by cutting the branches accordingly, and feeding the silk worms with them.

Some permit trees to grow up from the hedges as standards, at the distance of ten or twelve feet from each other. Thus rails might be fastened to the standards and form alone a good fence, even if, in the course of time, the old materials of the hedge should have been removed, or fallen into decay.

4. The dwarf orchard. The *dwarf orchard*, either consists of the dwarf or bush mulberry, so common in France; or of any mulberry species or variety kept in hedge size and cultivation.

As to the *dwarf orchard and mulberry*, we are informed by M. de la Brousse, that "the dwarf or bush mulberry has been cultivated for ages in the East Indies. It is there preferred to the tree with a high trunk, because its leaves are more easily gathered, the trimming less difficult and less expensive, and the sap having a shorter distance to rise, produces earlier leaves, and proportionably in greater abundance.

The tree with a lofty trunk must have a good soil and ample room, whilst the dwarf trees will grow anywhere, on an arid soil and small space. Extending their branches very little, they may be reached on all sides. They also yield an early leaf, and full as wholesome for the silk worm as that of the high tree.

The grafted dwarf mulberry of good kinds, such as *la rose*, putting forth as early as the *pourette*, is a valuable resource in a warm climate, where silk worms succeed only when they are raised before the more vehement heat sets in.

The field selected for an orchard of the dwarf mulberry ought to be ploughed, and after remaining in the furrow about two months, to be manured and cross-ploughed, and lastly levelled with a harrow. Lines must then be drawn *nine feet apart* through the whole length of the field, and the young trees must be planted along those lines at the distance of *six feet from each other*. Frequent tillage, manure every year, and watering in dry seasons are requisite particularly during the first years of their growth. The hoe may be employed, if the plough cannot, since their stems are so short as to send forth branches within a foot of the soil.

After the gathering of the leaves in the third year, the dwarf mulberry may be trimmed, but not before. Then it will be necessary to leave four branches at proper distance towards each of the cardinal points, in order that they may form, in the three succeeding years, the head of the tree. At the end of that term, each tree will nearly touch its neighbour, and ought every following year to be pruned immediately after the gathering of the leaves. *This trimming, amongst the French, consists in lopping off the branches that have yielded leaves during three years*, and reserving the wood of the preceding and of the current years. The height of the trunk of a dwarf being regulated at a foot, and its branches spreading, in the second year, about two feet and a half in all directions, they would

be within the reach of the smallest cattle, which must therefore be carefully excluded.

But the dwarf orchard may consist of any of the varieties of the black, red, or white mulberry, provided that they are kept in dwarf cultivation. This method is well adapted for this country, and recommended because, 1. The trees thus arrive to a state of productiveness with comparatively little expense of time and labour. 2. Sufficient sun and air are admitted to the trees to render the leaves of the first quality, and to enable them to put forth early. 3. The ground is more suddenly and completely filled and occupied than by planting standards. 4. The trees are more easily managed, and their form controlled. 5. The leaves are more easily gathered, and very readily by women and children.*

It has been recommended to have the rows of the dwarf orchard sufficiently distant to allow a horse and cart to pass between, to convey, during the gathering, the leaves with the greater expedition to the cocoonery. Mr. Roberts objects to this, because the pressure of the horse and cart on the intervening space might be such as to injure the vegetation of the trees. To avoid which he recommends that the leaves should be gathered into large baskets, and conveyed to a cart conveniently situated; or rather, that light hand carts propelled by men should be substituted.

Over ground duly prepared, as before directed, extend parallel lines, in number sufficient to cover the whole breadth, *eight feet asunder*. Along these lines, whilst kept straight, at the distance of *two feet apart*, dig cavities for the reception of the plants, into which cast some good rich mould; where the seedlings of two years old are to be transplanted, and the earth

* In India and Persia, the dwarf orchards are not, for the above reasons, suffered to rise above eight feet. At Broossa, in Turkey, they are planted within three feet of each other in rows not exceeding ten feet asunder; and always so pruned that a man standing on the ground may reach the top.

immediately pressed around them. The young trees are to be headed to about a foot from the ground, and but two or three branches allowed to grow. These, by pruning, are made to diverge, continually sub-dividing in every direction above the horizontal, so that every part of the tree be duly filled with young wood and leaves. Suffer no *vertical* shoot to rise in the centre, and curtail all straggling shoots near the top, and all pendulous shoots below. The tree is not to be suffered to spread wider than about two feet, towards the wide or middle space, and the rows must ever be preserved within four and a half feet in width and about ten feet in height. The ground in this way, may be cultivated with other various productions, especially during the first years.

Indeed, it has been recommended by some, to give to the ground applied to dwarf orchards or hedge plantations, the benefit of meliorating crops, because the soil, according to this opinion, becomes improved, and the intervening crops defray all expenses in the culture of the mulberry.*

* On this subject, we cannot quote a better authority than that of Mr. Goodrich, president of the Hartford County Silk Society. "I advise you to set the rows of mulberry trees at the distance of *eight feet.* This will allow sufficient space to *plough between* the rows with *a yoke of oxen*, or to pass between them, *with a one horse wagon*, when the trees are considerably grown.

"I would transplant the trees when they are *one* or *two* years old, and set them in the rows originally at the distance of *two feet.* They will grow for two or three years within two feet of each other. You will then have more than 2700 trees on an acre.

"It is important that the young plants should be *hoed* and *cultivated* for a few years, with as much care, as is usually bestowed on carrots or onions; and, in order to do this with as little expense as possible, potatoes, beans, or ruta baga, may be planted between the rows. And when the potatoes are hoed, all the weeds around the mulberry trees must be carefully destroyed.

"When the trees are three or four years old, and have begun to spread and fill the ground, I would *thin* them out, by digging up and transplanting every other tree. Experience will enable you to decide at what time this is proper to be done.

"I ought to have added above, that potatoes should be between the rows, well manured; so that the whole ground may be rich like a garden.

There are some who, both for the purpose of stirring the soil and keeping it light, between the rows of the young trees, as well as that of defraying, during the first years, the expense of planting and trimming

"I observed the last year, that the young mulberry trees grew as well where potatoes were planted between the rows, as where they were omitted.

"I would begin to *prune* the young trees the *first* year, and continue it every year. Observing to cut off all sprouts which grow near the ground; no leaves ought to be suffered to grow nearer than two or three feet to the ground. The earlier you begin to prune, the easier it will be to form good trees, and the more rapidly they will grow.

"The second year I would begin to make silk of the *twigs* which are trimmed off. If the trees have been properly cultivated from the beginning, I think you may make silk enough the second year, to pay all the expense of making the silk and of cultivating the trees that year. The principal object, however, ought to be, not to make silk the second year, but to cultivate the trees in the most judicious manner. I would, therefore, advise, that for the two or three first years, the trees should be trimmed, and the leaves gathered, only by persons who know how to trim the trees properly.

"When the trees are *four or five years old*, at which time they will be *six or eight feet high*, I propose to gather leaves for the worms, by cutting off twigs or small branches, which may be done by a person standing on the ground, still observing to trim the trees in such a manner as will best promote their growth. At Mansfield, in this state, the leaves have usually been stripped with the hand from the branches, and the person who gathers them is obliged to climb trees thirty or forty feet high. I propose to save this labour, in a great measure, by trimming and heading down the trees from year to year, so that they shall not grow more than six or eight feet high, and in such a manner that the leaves may always be gathered by a person standing on the ground. In this manner, leaves are gathered in Persia and in the vicinity of Constantinople.

"The leaves, or rather branches, are to be conveyed to the cocoonery, in one horse wagons, and you will now see the propriety of leaving the rows sufficiently apart for wagons to pass between them. I propose also to gather the leaves or branches in large baskets of a proper shape, adapted to the wagons. I suppose that one man with a wagon, will carry these baskets of leaves to the cocoonery as fast as a number can fill them.

"I found the last year, that leaves which grew near the ground were covered with sand or dirt, thrown upon them during showers of rain; and it was necessary to clean them thoroughly, before they were given to the worms. The labour of doing this was about equal to that of gathering the leaves. This suggested the propriety of trimming up the young plant from the beginning, so that no leaves should grow near the ground.

"I omitted to mention that the potatoes which may be grown the first

the orchard, before it is directly productive, recommend the culture, as will be seen by the subjoined note of intermediate crops. It is, however, proper to state here the opposite opinion. We add that expressed by M. de la Brousse, since it comprises much under the head of SUBSEQUENT CULTURE. After recommending as to standard trees, between rows, two dressings of manure, a year, he says, "It is almost an unpardonable sin to sow or plant a piece of land covered with the mulberry of high growth; but it would be an act still more inexcusable to sow with grain, or with that of any other produce, an orchard of these useful trees newly set. Though the ground be not wholly covered, and but partially shaded with these small trees, yet any grain, roots, or grass, would exhaust the soil, retard the activity of the sap, and obstruct the expansion of every part of the tree. *Nemo duobus** is a maxim so true in agriculture, that every proprietor, who has attempted to take at the same time two full crops from the same land, has unwisely exhausted the soil, and finally diminished his income. By manuring well our fields, and requiring but one crop at a time, we shall make better harvests, and receive a better rent." Mr. Vernon, the translator, adds, "the whole of this ought to attract the notice *of the farmers of our own country.* For it is the general usage with them, to take a crop of grain, of roots, or of grass from their orchards. This custom, so inconsistent with sound reason, added to their careless treatment of the trees, is the cause of that infertility of which we hear them so often complain; and it also very materially affects the

year, between rows of seedlings, will, as I think, pay for settting out and cultivating the plants that year. When the mulberry trees have grown to a considerable size, and the roots have filled the ground, it may, perhaps, be advisable to discontinue planting potatoes between the rows, as the roots of the trees would be impaired by ploughing the land."

* M. de la Brousse means, of course, "No soil for two crops," whether *nemo* be classically applicable to any thing inanimate or not.

quality of the leaves and fruit. At Montreuil, a village of nearly 20,000 inhabitants, all maintained by the cultivation of fruit for the supply of the city of Paris, a proprietor will not allow even a plant of lettuce to be grown near fruit trees. Every particle of the surface of the ground is there kept in a friable state to the full extent of the roots of the trees; a due proportion of manure is every year worked into the soil, the art of trimming is there perfectly understood and practised; and there we never hear *the barbarous assertion that the apple tree bears well only once in two or three years.*"

5. The making of HEDGE PLANTATIONS is now also recommended. It consists of a piece of ground, not only fenced in, but its whole interior planted with mulberries in regular rows at certain distances kept in hedge culture. A plan which will be found convenient during the leaf-gathering season; especially for children.

It was formerly the practice in France to plant out the mulberry as standards, and to suffer them to attain a considerable size, for which gathering ladders and additional labour were indispensable. The practice is of late much changed. It was observed, says Rozier, that the young plants in nurseries, put forth their leaves much sooner than the standard trees; and the necessity of obtaining early food for the young insects obliged the cultivators to provide themselves with a certain number of mulberries in the bush, shrubby, or hedge state.

From these first experiments arose the prevalent practice of raising dwarf mulberries extensively, and also of surrounding the fields with mulberry hedges. It is said that the produce of an acre in dwarf mulberries is much greater than one in large trees, the distance between the plants being so much less, so that the number of dwarfs may be eight times as great. This is admitted to be true at first, though some cultivators deny that it continues to be so after the standard trees have attained their full size. But

whether the increase of the foliage of the full grown standards is such over that of eight times the number of dwarfs, as to countervail the additional expense in the gathering of the former, is a question, that experiment, fairly conducted, alone can decide.

In India, in China, in Turkey, and, at present, in France, hedge or dwarf plantations are most highly approved; and the system is gaining ground also in Italy and Belgium. M. Bonafoux, the celebrated writer on silk, and the disciple of that "*facilé Princeps*" *of silk worms*, Count Dandolo, and the director of the Royal Gardens of Turin, highly recommends this mode, of cultivating in *mulberry prairies*, as in China.

Dr. Tinelli* says, "this method is now generally adopted in Italy. 1. Because the produce of the little mulberry is much earlier than that of the large one; for in the third year they begin to gather the leaves from hedge rows, while six years are required before we can strip the large trees. 2. Because the low trees, being more immediately affected by the warmth of the soil, begin to put forth their leaves *fifteen days earlier than the larger ones*, which is certainly a great advantage. 3. The care of low trees and the gathering of the leaves are left to children, which is a considerable saving of expense. The trees of low size, *planted in hedge rows*, occupy the least possible space, while at the same time they supply a crop as perfect as those of a greater height, and their leaves, extremely agreeable to the worms, furnish a silk of the first quality."

Of *hedge plantations, there are two plans.* The FIRST PLAN we have thus well described by Seignor Tinelli: "For the purpose of making plantations of this kind, young trees of one year's growth are used. The *hedges* are planted in lines, extending the whole length of the field, and the lines (or rows) separated from each other by a space of *six feet*.† Each tree

* Doctor of Civil Law of the University of Pavia.

† "Eight feet." Silk Cul. vol. ii. p. 181, col. 1, giving 2000 *trees to the acre.*

is planted at the distance of *three feet* from the next in the same row. So that *in the space of an acre, or* 43,560 *square feet, we shall have* 2420 *of these trees. They will yield, in their third year, about* 2 *lbs. of leaves each;* (*or* 4840 *lbs. for the acre;*) and this quantity will be doubled annually, till the eighth year, provided they are cultivated, attended to, and managed as required."

The above statement of Seignor Tinelli leads to the following statistical consequence; the trees on one acre for the

3d year yield.... 4,840 lbs. of leaves.
4th year yield.... 9,680 lbs. of leaves.
5th year yield.... 19,360 lbs. of leaves.
6th year yield.... 38,720 lbs. of leaves.
7th year yield.... 77,440 lbs. of leaves.
8th year yield....154,880 lbs. of leaves!

Which in this case, on the eighth year, would be equal to* 1548 lbs. of silk, worth $7740.†

Although the young trees when planted, are furnished with very small roots, yet it is necessary to dig the trench made to receive them of considerable depth. It is usual to make it one foot and a half deep, and of the same breadth. When the little trees

* 100 lbs. of leaves of the white mulberry are reckoned to be equal to one pound of raw silk, now worth at least five dollars.

† The above statement of Dr. Tinelli we have given, merely to show how extravagantly great men—men who are looked up to as great authority, will wander into the regions of fancy when they are supposed to be furnishing facts. It must be obvious to all that the quotation above, and the subsequent statement legitimately drawn from it, are erroneous. But much of what is written on this subject, is not any thing more accurate; and if we advert to the widely divergent statements made by authors in our own country, upon the culture and produce of the mulberry tree, we need not be surprised that such things come from abroad. One tells us, that the mulberry tree should be planted on *high*, another on *low*, ground; one on a *south*, another on a *north* exposure; this one on *stony, gravelly* soil, that on *sandy loam;* the next on any soil that will produce vegetation, the opposite excludes us from almost any soil that can be procured. These unsettled and uncertain opinions remind us of the Scripture phrase, "If the trumpet give an uncertain sound, who shall prepare himself for the battle?" In these pages we shall present a better view of these subjects, with more certain data.

are set in the ground, the stems are cut so as to leave only three eyes above the ground.

The SECOND PLAN of *the hedge plantation*, and also its cultivation, is best described by Mr. Roberts. "At two years old, the plants may be planted out into *hedges*, at *eighteen inches apart*, in rows *eight feet asunder*. The ground should be prepared as before directed, and some good rich mould put into the holes, to be afterwards pressed around the plants. Take care that the two lowest buds be in the direction of the (gardening) line; which should be drawn straight. The plant is to be cut down to these two buds, about half a foot from the ground. By the ensuing spring these buds will have become two beautiful branches, when one of them is to be pruned down to one foot, and always on one side of the plant. The branches on the opposite side to be left uncut, but to be bent in the direction of the hedge towards the lopped branches, and fastened to them with willow withs so as to form an arch. The third spring the plants will have branches to form a hedge, when they must be cut about two feet from the ground, leaving the branches below that point entire. When plants die, replace them by layers from an adjoining one, as the introduction of new plants hardly ever succeeds. The hedges should never be permitted to grow higher than six feet, so as to keep them within a convenient height for gathering the leaves. After the leaves have been gathered, they should be pruned, and particularly of such branches as may have been injured or killed. All dead branches, also, thus found in the beginning of April, must be pruned from the living wood, with sharp hedge shears, and these prunings should be so regulated as to give a proper form to the hedge."

The planting of morus alba in the hedge form, will be found to be the most advantageous. The same quantity of land will thus produce at least eighty per cent. more leaves, than from standard trees; the labour of gathering leaves is full one half less, and the vegeta-

tion is much quicker. These certainly are considerations worthy of attention. A few standard trees, or a *plantation of standards*, should be kept on every estate, and particularly where situated in the interior, for the purpose of keeping up regular supplies of seed, and of making that of leaves doubly secure.

6. PLANTATION FOR STANDARDS is a piece of ground, on which, at proper distances, mulberry trees, designed to arrive at, or that have attained to, full growth, are planted.

The distances generally recommended for this purpose are *twenty feet between the rows*, and *twenty feet asunder*, i. e. *twenty feet every way*. But here the quincunx order would probably be an improvement. That is, the rows twenty feet asunder as before, and the trees in each row, twenty feet distant from each other, but each tree of every alternate row placed opposite the centre or middle point of the nearest two trees of the opposite row; so that each tree of one row forms an isosceles triangle with the two nearest trees of the next row. An advantage is thus gained in every case, where between two opposite trees only twenty feet would intervene, of two feet and one-third, both for the extension of branches, and the freer admission of both sun and air.

Let then this piece of ground intended for such a plantation be first described into lines or parallel rows, twenty feet asunder. on each of which rows dig cavities twenty feet, also between one and the other on the same row. But let the first cavity on the second row be dug precisely opposite to the centre point between the nearest two on the opposite row; and thus continue for every other cavity and every other row; and we shall then have a plantation of the quincunx order. This quincuncial order derives its name from the numeral V, which is called the single quincunx; and the numeral X, which was termed the double quincunx. Of all arrangements, the quincunx order combines the most advantages. More trees may thus be set at any distance apart on the

same area than in any other mode. Each tree will have the same proximity to its neighbours on the same row, but all will enjoy superior facilities for the admission of air, heat, and light.

The land where the trees are to be set, will be much better for the purpose, if previously ploughed, harrowed, and manured on the preceding autumn. It will be proper to transplant only handsome, well-selected subjects, and which are not getting too old in the nursery, crooked, knotty, or mean looking. It would be desirable to ascertain the position of the plant when in the nursery in reference to the south, which may be easily discovered, even when sent from a distance, by the magnitude and number of its roots, which are generally larger and more numerous on the south side of the tree, as well as by the size and distance of the rings which form at the forks of the branches. Directed by these signs the tree may have the same side turned towards the south, which it had before its removal, by turning in that direction the largest roots and circles.

The transplanting may take place either in *spring*, as soon as the frost is out of the ground, or in *autumn* at the fall of the leaf. Not a few prefer the former season. Mr. Gideon Smith of Baltimore, whose judgment unquestionably ranks high, gives the preference to the latter, in order to let "the small fibrous roots which convey nourishment to the tree, have time to prepare for their functions by the vegetating season of the next spring."*

When the plants are grown to the size of one† inch

* From an authority so respectable as Mr. Smith, however, we must beg leave to dissent. In the south where there is comparatively no winter, or at least a mild one, his system will answer very well, perhaps be the better plan; but in the eastern and middle states, where the winters are severe, the method of fall planting, recommended above, would be exceedingly questionable. The gain would not be so great as to put to hazard so great a stake where the seasons are so rigid, and the spring planting, in this climate, is, we think, greatly to be preferred.

† The French practice directs, six inches in circumference at the

in diameter, and from seven to eight feet high, they are fit to be planted out into the field where they are finally to remain. Let them be dug up without injury to the roots, and, whenever practicable, transplant immediately, or soon as possible, after removal from the ground, without cutting off any thing.* Whenever the planting cannot be immediately effected, the roots must be surrounded with straw wrapped around them.

Let each cavity for the reception of the trees, at the distances already stated, be made *eighteen inches deep*, and *five feet in diameter* and its lower part covered with a few inches of fresh mould. The young tree is placed in its proper range, ascertained by a stake fixed at each extremity of the line, and it is to be held there till its roots are covered with friable and well manured earth free from stones, which must then be well trodden down, and watered if necessary.† A small furrow left round the stem to retain the rain is very proper.

Leave all the buds which the young trees have pushed out on the top, till the following spring; when none are to be left, but three or four branches to form the head of the tree. These should be so left as to form a circle round the stem. That the interior of the tree may be kept open, all buds as they appear on its body should be pinched off for a few years. The head of the tree also, for several years, should be thinned out, cutting off such branches as cross

bottom of the trunk, and from six to nine feet in height. Others say, the plant ought not to be more than three years old when taken from a rich soil, or four years old, if removed from poor land.

* Except what is bruised or broken just above the defect. Yet some say the roots should be trimmed.

† The practice in France, with some, is, in order to give immediate activity to the sap, as well as to make the earth on all sides closely adhere to the roots, to pour six or eight gallons of water into the cavity, which is then filled with earth to the surface. But the season, wet or dry, and the proprietor's experience and discretion will vary this according to circumstances.

others, or take the lead of the rest: equality in growth and beauty in appearance will be thus preserved. Every spring, the young trees should be dressed two or three feet around the trunk; and stakes also should be placed by each, and fastened to it at the time of planting, to prevent its position being altered by strong winds.

When the trees shall have nearly attained their growth, two top dressings of manure a year will preserve them in an improved condition. The first may be given in the month of March, or the time of the first rising of the sap; when after hoeing, they ought to be treated with a proper quantity of manure. The second tillage must be given immediately after gathering the leaves, in order to promote the August growth, on which the produce of the following year so much depends.

Grafting and budding are methods of culture long practised, especially in Europe, and *supposed* to improve the several species and varieties of the mulberry. The only reasons assigned by a recent writer to warrant the neglect here of these methods, is because with us, land is cheap and labour high. More weighty and decisive reasons, however, than these exist; and we shall find them most strongly expressed by authors, who are themselves natives of the countries where these methods have been the longest tried, and through the current of *imitative* custom, *not investigation*, have been the most popular. Count Dandolo says, "fourteen pounds and a half of *wild** mulberry leaves will produce one and a half pounds of cocoons; whilst it requires twenty pounds and three-fourths of the leaves of the *grafted* mulberry to yield the same quantity." Again, "Seven and a half pounds of cocoons proceeding from worms fed on the leaves of the wild mulberry, give about fourteen ounces of exceedingly fine silk; whilst the same

* I. e. not grafted.

weight of silk worms fed with the leaves of the grafted mulberry only yields eleven or twelve ounces of silk: that the silk worms fed on the wild leaves are always brisker, and have better appetites." M. Morin informs us, that "the mulberry trees *not grafted*, last for ages,* whilst the *grafted* after twenty-five years fall into decay." No other additional reason needs be assigned for the entire abolition, in this country at least, of *grafting*, *budding*, and *inoculating*, of such vivacious and even indigenous trees as mulberries, than that the superiority of the multicaulis, for which no such process is necessary, is now so far decided, as to render attention to the engrafted and artificial varieties, so far quite unnecessary, that a page or pages occupied with the detail of these tedious and laboured manipulations, would be at once a misapplication both of our limits and of the reader's time and attention.

Pruning. Trees left to themselves are liable to assume forms as unsuitable to the taste of the horticulturist, as they are inconvenient to those engaged in the gathering of their leaves. *June* is the *best season for pruning*, when the young twigs that are taken off may be, with advantage, given to the worms. But after what has been already said on this subject, it is here only necessary to add, that the imperfections in the form and growth of trees, may easily be remedied by a judicious cultivator, at least once every two or three years.

Suckers. Trees may also be obtained from suckers. These, each with some roots attached to them, may be separated from the tree early in the spring, planted in the nursery or orchard, *two feet* apart, where they may remain until their size intimates the propriety of transplanting. They must be treated as

* The black mulberry tree adjoining Greenwich Park, planted in the reign of James the I., now covers a circumference of 150 feet, and yields during the season eighty quarts per day of the finest mulberries in England.

seedlings or cuttings; watered in dry weather and kept clear of weeds. Though the white mulberry admits of this variety in its mode of propagation, yet no method, as yet, has been found preferable to that of reproducing it from its own seed or fruit. The modes of reproduction from *cuttings* and *layers*, alike applicable to both the species and varieties of the mulberry, are so particularly suitable to the hybrids, and especially to the multicaulis, that we defer what is necessary to observe on these subjects to the next chapter.

In the complete silk establishment, the *nursery*, *orchard*, and *plantation*, will require their INSTRUMENTS; as well as the *cocoonery* its *furniture* and *utensils;* and the *manufacture*, its *machinery*. In the former we should be supplied with the *weeding hook*, *pruning chisels*, and *shears* adapted to different parts of this work, and suited to different altitudes. For the plantation for full grown standards there should not be omitted a *pair of pruning shears* attached by one of the handles to a ten foot pole, which whilst it is held in one hand, is worked by means of a cord passing through a pulley, and attached to the other handle by the other hand. By this means twigs and branches, though at the height of seventeen or eighteen feet are taken off with ease, and that so smoothly as neither to lacerate the bark nor injure the appearance of the tree. *Hoes* also will be necessary, particularly one adapted to the mulberry orchard culture and described by Messrs. Cheney in the early numbers of the Silk Grower. In very dry seasons, the proximity of *a pond*, or one in the midst of the plantation, with *a forcing pump and hose* to send the water to every part, will be of great advantage.

On the following cut will be found a representation of the *M. alba*, *M. tartarica*, and *M. nigra*. The M. alba on the right, the M. tartarica in the centre, and the M. nigra on the left. They exhibit the leaves and fruit drawn from nature. It has not been thought necessary to give a representation of the other species

under this head, as they are different only in size and in few peculiarities of the leaves which have been previously described.

CHAPTER III.

THE MORUS MULTICAULIS.

It is now universally known amongst all experienced culturists, that the MORUS MULTICAULIS is a *hybrid;* and as the most judicious and discerning amongst them think, that it is a variety produced from the *morus alba* and *morus nigra;* and therefore whilst it yields silk having all the *delicacy* of the proceed of the former, combines the strength, without the comparative coarseness of that of the latter; and consequently is in itself the complete "*utili dulce*" of the mulberry tribe. It is to the national-stirring industry, and wealth-giving properties of this tree, that the disciples of Confucius attribute the prosperity and solidity of an empire that knows no parallel on the face of this earth. It came here recently as a stranger, and had its own character to substantiate; but with it, as with every thing of intrinsic excellence, this was soon and easily effected. In its favour, the verdict of the well known culturist,

Gideon B. Smith, of Baltimore, has been quoted. "Whoever," says he, "is desirous of entering into the silk culture, must now abandon every idea of cultivating any other kind than this; as from its superior fitness, in every respect, to the feeding of the worms, it would be impossible that any one growing any other could compete with those who fed with it. That as there is no offal from coarse fibres, fully one third of the labour of gathering will be saved. That the leaves of the multicaulis yield a finer silk, more delicate in texture, and brilliant in gloss than any other kind." But now, independently of all private opinion, however eminent, by experiment and matter of fact, a thousand times repeated, whether they refer to the possibility of its acclimation in our Chinese-parallel climes, its fitness for the worms, the immense saving of labour which it affords, or to the superior quality of its produce, its fame is known and acknowledged, without a dissentient voice, from Maine to Louisiana, and from the Atlantic to the Western shores of the Mississippi.

As an object of public attention, it is now one of such intense interest, that inverted must be the telescope of the man that has not the prescience to discern that a new and a great era is now about to open in this country. What will be the ultimate benefits, it is now impossible to calculate. If the first advantage accrue to an individual, it extends to his neighbour and thence to a third, and thus on in the great *catena* of society, from link to link, till the individual blesses the nation, and by reciprocity the nation the individual, until national prosperity and individual contentment merge party and comparatively petty differences into an equanimity, that may leave China herself dispossessed of the singularity, in this respect, of which she at present boasts. As such it would be almost impardonable, in a work of this nature, not to give, even as a tribute of gratitude, the history of a tree, to which we are all likely to become so much indebted.

The first complete history and account of this plant appeared in the "Annales d'Horticulture," and the "Annales Royal Horticule de Fromont;" and were afterwards collected and inserted by the Hon. H. Dearborn in the "New England Farmer" of 1830 and 1831. From which it appears that the honour of the discovery of this plant, and its introduction to Europe, to Africa, and to America, is due to M. S. Perrottet, agricultural botanist and traveller of the marine and colonies of France. This distinguished botanist was sent out by the government of France on a voyage of research to the seas of Asia, a national ship having been provided especially for his use. After an absence of nearly three years he returned to Havre in 1821. He brought with him *eighty-four boxes* of various dimensions, containing *one hundred and fifty-eight* species of living plants, of at least eight feet in height, to the quantity of *five hundred and thirty-four* individuals. All these productions had been procured on the coasts of Asia, or gathered in the lands of Cayenne. From the commencement of the present century there had never been so vast an importation into France, or one so extensive in number, and at the same time each so remarkable for rare genera, species and varieties. In this immense collection was the *morus multicaulis*, thus called by Perrottet for the first time, and ascertained by him to be the real *Chinese mulberry;* or as sometimes improperly called the *morus alba sinensis.*

It was in descending the river which traverses the city of Manilla, the capital of the Philippine islands, and on its banks, and in the garden of a Chinese cultivator, that M. Perrottet saw, for the first time, the multicaulis. It was there that he first found it growing with a vast variety of other precious plants, which had there been collected from India, from Ceylon, from Sumatra and from China.

The multicaulis appears from the statements of M. Perrottet to have originated in the elevated regions

of China, and from thence to have been disseminated over all the plains near the sea shore. It was introduced into Manilla, and into all the islands in the Asiatic Archipelago, from Canton.

The morus multicaulis has had already many names assigned to it. It has been called *morus manilla*, from Manilla, where first discovered, which is the capital of the Philippine Islands, hence also its second name *morus philippina ;* from the *hooded* convex, or bowled form of the leaves, it has been also termed the *morus cucullata ;* from the name of its first European discoverer the *Perrottet mulberry ;* but Perrottet himself called it the *multicaulis, many stalked*, or mulberry with many stems ; and by way of eminence the *Chinese mulberry.* To the name *morus nigra sinensis* there is no objection except that in it there is no word to express that it is a mere hybrid or variety ; but to the name *morus alba sinensis*, which we find has been ascribed to it, we do object, since its fruit is black and not white. Many names for the same thing are generally productive of confusion. This has been verified ; since there are not wanting several who, from these diverse names, have supposed the existence of so many different hybrids, or even of so many distinct species. Had the just conviction of M. Poiteau been originally adopted, who observed that "public gratitude and justice require that the name of the zealous traveller should be affixed to the valuable plant, which has given him celebrity, and he has given to Europe, to Africa, and to America," the ambiguity would have been avoided in a way whose propriety none would have questioned.

From Manilla, the multicaulis was first introduced by M. Perrottet to the Isle of Bourbon, and from thence into Cayenne, and afterwards to France, where, at first, its culture was confined to the Royal Gardens. At a later period, it was sent from Cayenne to Martinique, and from France to Guadaloupe, and also to Senegal. The numerous plants now dissemi-

nated through the diverse climes of Europe, Africa and America, are all the proceed of the two individual plants brought by M. Perrottet from Manilla.

M. Poiteau, M. Eyries of Havre, and Chevalier Bodin of Paris, have informed us that this plant has braved all the winters since its introduction, and prospered in all climates in France. M. Bonafoux, the director of the Royal Gardens at Turin, and the celebrated writer on silk, has also fully attested its decided superiority in Italy, where he has found that, by close planting and low pruning, whole fields may be suddenly covered with a mass of the most luxuriant foliage. M. Dupont of Chiron, near Chamberry in France, also found that, as the silk worms fed on this mulberry make less waste of litter and of food, so the chances of disease are diminished from this cause, and they finish their labours in less time, producing silk of a more brilliant lustre. He also found that the saving of labour, in gathering the food, is so great that *ten quintals of the leaves of the multicaulis are gathered in the same time which is requisite to gather two quintals of the leaves of the common white mulberry.* By the most perfect rules of pruning, he makes this mulberry assume the form of a *quenouille*, or vast distaff, fifteen feet high: the form to be always preserved.

Dr. Deslongchamps, in his experiments at Paris, had found that the cocoons produced by the worms fed exclusively on the Chinese mulberry, were even heavier than other cocoons. And in the report, on this shrub, to the Academy of Dijon by M. Tilloy, in 1834, we learn that it appeared by accurate experiments that the cocoons produced from this variety being rather heavier, the fibre was consequently stronger; and it was remarked in winding 384 cocoons that not a thread was broken.

Near Montgeron in the north of France, the French have established an experimental silk farm under the direction of M. Camille Beauvais. And the extraordinary experiments, which are there in progress, were

published in 1835. Already had he succeeded in producing thirteen pounds of silk from the same number of silk worms, which in France usually produced but five pounds, in Italy seven pounds and a half, and in India twenty pounds. And even in his climate, M. Beauvais expects soon to be able to produce, with the aid of the multicaulis, an equal number of pounds from the same quantity of silk worms as the old practitioners of 4000 years.

In Tuscany, so fine is their climate, that two successive crops of silk are annually produced from the common mulberry; and Dr. Deslongchamps has proved that, by the aid of the Chinese mulberry, two crops of silk may be annually produced even in the north of France. And, in this country, the celebrated prediction of Dr. Pascalis that, "*after the discovery of this plant, a doubt no longer existed that two crops of silk may be produced in a single season,*" has been repeatedly verified.

Every thing relative to the history of the multicaulis in this country that is necessary on our part to give, is combined with other important matter in the following extract from the correspondence of one on whose testimony and opinion we can rely. "I was the first person south of New York, who had the morus multicaulis. It was sent to me by Wm. Prince and Sons, in 1828,* in a collection of seven other varieties of mulberry. It was not then known by the present name, but it was called the Philippine mulberry. About a year after I received it, accounts arrived from France of the receipt there of the multicaulis, and of its great value for feeding silk worms. On examining my trees, I at once found that my Philippine mulberry was the multicaulis, and immediately commenced feeding my silk worms with it, and from experiment ascertained the truth of all

* From this we may suppose that Messrs. Prince & Sons possessed the first multicaulis tree in North America; probably in 1827. Mr. Kenrick dates the time of its first introduction into New England in 1831.

the French had said about it. From that time to this, I have continued to urge upon all, the propriety of cultivating this in preference to the white mulberry. Its advantages are, 1. *It is full as hardy as the white:* 2. *One pound of its leaves contain as much nutritive matter as a pound and a half of the white:* 3. *The silk made from it is of a finer texture and more lustrous:* 4. *Its leaves are so large that a pound can be gathered at half the expense and trouble that a pound of white mulberry leaves require:* 5. *It can be cultivated with infinitely more despatch than any other kind.* These are all great advantages. In relation to the hardiness of the multicaulis, I observe that I have cultivated it for seven years; never protected it in any manner whatever, and never lost a tree. I have seen the young *unripened wood of all* varieties destroyed by the winter, and was very early led to adopt measures to guard against it, and now I never lose a bud."*

The morus multicaulis grows vigorous, upright, and beautiful; the leaves are large, soft, and tender, petiolate, cordate, acuminate, serrated towards the summit, marked with nerves, always entire; their upper surface is convex, bowled or curved; of a deep and beautifully shining green. The form and dimensions of the leaf vary in different soils. In a dry and arid soil, their size is less, their form elliptical and without the heart-shaped indentation at the base; their breadth in this case being six inches, and their length eight; but in a light, rich and friable soil, the produce of the foliage is most abundant, the leaves large and cordiform; extraordinary specimens having sometimes measured more than a foot in breadth and fifteen inches in length.

Each male flower has a calyx of four concave, oval, membranous leaflets, four stamina, with filaments accompanied with a tridentate appendage;

* Letter to the Farmer and Guardian from Gideon B. Smith, Esq., of Baltimore, inserted in Fessenden's Silk Manual for February, 1837.

anthers sagittate, bilocular. Each female has an ovary, terminated by two divergent styles. The ovary is unilocular, containing a single pendant seed, which is frequently blasted or imperfect.

A comparison between the white Italian mulberry and the morus multicaulis, is thus stated in the third volume of the Silk Culturist. The *white Italian mulberry* requires *four years'* growth before it can be safely fed from, *six years* before remunerating profits can be obtained from its foliage, and *twenty* before it can be said to have attained its full growth.

The *morus multicaulis* tree can be fed from *the first season without injury;* the *second season* it will yield nearly as much foliage as at any subsequent period. It may be multiplied from cuttings to an almost incalculable extent. Every piece of wood with a single bud, being competent to make a shrub *from four to six feet high the first year:* whereas the white Italian mulberry requires four years before it can be fed from, and even then to nothing like the extent of the former.

The leaves of the *morus multicaulis* are nine or ten times as large as those of the white Italian mulberry; equally as nutritious, and are eaten with more avidity by the worms. They will make silk fully as lustrous and as elastic as those of the white Italian; and from the great size of the leaves of the former, it reduces the labour of gathering and feeding seventy, eighty, or ninety per cent.; but for the sake of accuracy, we will say fifty per cent.

An acre in morus multicaulis, *two years old*, will yield by one half more foliage than the same quantity of ground in the white Italian mulberry, *six years old;* when a leaf of the *former* is gathered, food is provided for nine or ten worms; whereas a leaf of the *latter* only suffices one worm. There is no more trouble in gathering the large leaves of the multicaulis, than there is in those of the morus alba. The labour of feeding is the same, with this difference, that in feeding with one of its leaves, you accommo-

date nine times the number. In the leaf of the multicaulis there are but few stems, and scarcely any that are not eatable by the worm. In that of the morus alba the stems or uneatable fibres, compose fully *one-third* of its weight, all which is waste and loss.

In feeding with the multicaulis, the residuum being but little, there is no vegetable offal remaining to become noxious by fermentation, and hence a greatly *reduced quantity* of labour is necessary to keep the whole cocoonery in a salutary state. In feeding with the white Italian mulberry, a large amount of stems and coarse fibres are left on the shelves, which, if not speedily removed, ferment and become productive of disease."

This comparative statement, the Messrs. Cheneys, who are regarded in the light of practical men, fully confirm as follows: "It takes *five years*, at least, to grow off the white mulberry sufficient to afford foliage to feed many worms. But from the multicaulis *of the first year's growth*, we have fed worms in such numbers as to obtain from fifty to one hundred pounds of silk from the leaves growing on an acre of land, worth from 250 to 500 dollars." This, we must remember, refers merely to the amount of silk that may be obtained from the multicaulis, not within *five years* as would be the case with the white mulberry, but within five months of its being planted; but we shall hereafter see that the amount of silk to be obtained the second year is double that of the former. "It has another advantage of still greater magnitude. The leaf of the morus multicaulis is eight times larger than that of the white mulberry; therefore the labour of gathering it is reduced in the same ratio. This is a very weighty consideration, since the picking of the leaves is the great item of expense in making raw silk.* The weight of leaves

* The fact, that in two months after the cuttings of the morus multicaulis is planted, it begins to supply the silk worms, daily increasing as the worms pass through their several stages, so as to meet their wants,

which the multicaulis will produce, is a hundred per cent. more than the white mulberry affords, when the trees are of equal age and on the same extent of ground. This is not all. The multicaulis can be propagated more abundantly and cheaper than the morus alba or any other with which we are acquainted. That the multicaulis with proper management will endure the climate of New York and New England, we have abundant evidence. That it will flourish in Pennsylvania and the southern portion of the union is not, now, questionable. At the north the tree must be protected the first winter; at the south* even this is unnecessary."

is giving a crop of silk *sooner* than corn will give its yield planted on the same day, together with the easy facility of collecting the leaves, which, the first year at least, are *lower*, instead of *higher* than the smallest person that can be engaged to collect them, is the reason why the citizens of the United States have promptly sought this tree, and resolved to enter into the silk business at any price within their power to command.

* The cases of making large profits in a short time, both in the *multiplying* of this *multiplying stem or shoot* tree, as well as in the production of silk, the first year, are numerous. Instead of giving numberless examples, which it would be in our power to do, we will give one. "As far as I know I was the first that tried the multicaulis in *North Carolina*, by procuring one rooted plant about a foot high from Baltimore, four years ago, which cost me *a dollar*, beside conveyance. From this one I have since propagated several thousand rooted trees, not to name cuttings. I have sold to the amount of near *a thousand dollars*, (a *thousand dollars from one in four years*) and have a stock left worth *several hundred dollars*. My cuttings grew, with few exceptions, to five and six feet the first year, and in good ground to eight or nine feet in a season. My first propagated trees are sixteen or eighteen feet high. It is my purpose to unite in one establishment the vine and silk culture. And I hope thereby not only to profitably employ all the year, *widows, and children and the superannuated*, or the otherwise disqualified for hard labour, but to clear $500 per annum per acre from the silk, and $1000 per acre from the vine culture. This may appear to some an Eutopean scheme, but not to those who know the profits of the silk business, when properly conducted, nor to those who have witnessed the abundant and never failing yield of the Scuppernong vines."—Sidney Willer, Brinkleyville, N. C., Nov. 1837.

We have said that we could relate numberless similar examples; but it would be *amusing* to mention the case of the man, in this Philadelphia, two years ago *not worth one cent!* but his credit was good; on which he borrowed $100, the whole of which he invested, not in a

CHAPTER IV.

ON THE CULTURE OF THE MULTICAULIS.

It was for some time a question whether this invaluable shrub could be reproduced from its own seed; and for a time the dye spun doubtfully. It would be now useless to spend many lines on the subject: it is decided: the multicaulis is a *hybrid*, and cannot, from its own seed, in one case out of a thousand reproduce its like. It is true that the plant will produce *black* berries or fruit, and that but *sparingly*. It is further conceded that one seed out of several hundreds, or even a thousand, *may* produce the multicaulis; but all the rest diverge into varieties so numerous as to defy the patience of the most attentive phytologist to define them. To save our own limits, we refer to an article, which may be considered as the verdict of a jury of this country on the subject, on page 711 of vol. iv. of the Farmer's Register. We repeat it: the multicaulis is a hybrid. One seed out of many hundreds *may* produce its own like; the rest will not. Its reproduction, therefore, must be either by *cuttings* or *layers*. As for grafting, budding or inoculating, absolutely not one of them is worthy of either our attention, or of that of the reader.

It is asserted by a late writer that no kind of mulberry tree under cultivation, can be produced from seed. This is an error, which *all experience* at once disproves. It is only the hybrid kinds of which this may be said. The *white*, the *black*, the *red*, in short

silver mine, but in a tree, which yielded silver more rapidly than could the mine. After paying his debt, he is now worth considerably more than $3000!

all the distinct *species*, are constantly under cultivation from the seed; and they have thus, questionless, produced their like, since the creation, as they certainly have since their distinctive properties were first known. The error of the author in question can only be attributed to his utter unacquaintance with the history, genera, species, and varieties of the morus. Such inferences may be easily but rashly drawn, where the writer is unable to distinguish in the order of classifications, according to the established laws of phytology that relate to *tribes*, *order*, *genera*, *species*, and *varieties*. Without this knowledge, our experience is of little worth, since we are thus disqualified to mark with precision those distinctive attributes with which every one, that attempts to enlighten another, should be familiar.

It is further decided that any land suitable for raising a crop of corn, (some go so far as to say, of only ten bushels to the acre,) will do for cultivating the Chinese mulberry. A *dry*, *warm*, *sandy loam* is quite congenial to its nature. A *cold*, *damp*, or *heavy* soil, will not answer. *It will thrive tolerably well on poor land, but much better on that which is fertile.* Sunny exposures, and the declivities of hills, especially those which slope to the south, east, or west, are favourable. If the ground is to be prepared for layers, prepare it, as for corn, and at the same season furrow it into rows three and a half feet asunder. Then scatter *well rotted** manure into the furrows two inches deep. This mulberry should be cultivated in hedge rows, or not suffered to rise higher than seven or eight feet. But a few years are requisite to raise considerable fields of them in full vigour, sufficient to supply an immense number of silk worms; and regular plantations can be formed, by planting the trees in rows of eight feet asunder, and at the distance of three feet and a half in the rows; a space sufficient for the extension of the branches, for sub-

* This distinction is somewhat important, since it is even said, that *fresh* manure is poison to the mulberry.

sequent culture, and for the convenience of gathering the leaves. With the multicaulis cultivated on this plan, we are informed by M. Perrottet, that a child is sufficient, so flexible are the stalks, and the leaves so large, to supply with food a large establishment of silk worms.

We have taken it for granted that it is generally understood that the several distinct *species* of mulberry trees, or kinds capable of reproduction from seed, are best cultivated as we have already described in preceding chapters; and that all *hybrids*, or *varieties** incapable of reproduction from seed, can only be propagated by *cuttings* or *layers*. Of these methods, a description here for the multicaulis will suffice for the rest, and even for a species, whenever any should choose to cultivate it, in either of these ways, since in whatever way a hybrid may be propagated any

* To comprehend what is meant by a *hybrid* plant it must be understood that among the genera and species of trees there are different sexes. These sexes contain two or more whorls of transformed leaves, of which the outer are called *stamens*, and the inner *pistilla*. The stamens have at their apex an organ, called the *anther*, which contains a powder or the *pollen*. This pollen when the anther is mature, is emitted, and dispersed, or deposited upon the stigma. The action of the winds may bear it to a distance where other plants may be fecundated by it, as in some trees, the male and female being distinct trees, are thus affected.

The pistillum has at its base one or more cells, in which the *ovula* are placed; and at its apex one or more secreting surfaces called *stigmata*. These ovula are the rudiments of the seeds. The fecundating power of the pollen enters or falls on the stigma, and the ovula of the pistillum are vivified, and become seeds. But it is possible, by artificial means, to cause deviations from this law of nature.

If the pollen of one species be placed upon the stigma of another species, the ovula will be vivified, and a *hybrid* plant will be the product. These hybrids are different from both their parents, but the new species will have the general aspect of the polleniferous parent, but is, notwithstanding, influenced in other respects by the peculiarities of the female parent; a fact, in procuring new hybrid plants, which should never be forgotten.

Plants capable of being hybridized are those in which the sexual organs are prominently developed. To produce hybrids, therefore, plants must be selected from different species of the same genus, and should not be confounded with the spurious formations from admixture with the same genus and species.

other variety or even a species may; though on the other hand a hybrid cannot in every way be cultivated as a species, or raised from seed. We have, therefore, purposely deferred the whole subject relative to cuttings and layers to this chapter.

Cultivation by CUTTINGS and LAYERS is divisible in *four methods*, of which *two refer to cuttings*, and *two to* the method by *layers*.

1. CUTTINGS: method 1. *By previous forwarding the budding or vegetative process in frames or under glass.* Let there be prepared, before the month of March, frames or boxes, of convenient lengths, and sufficient in number to contain the cuttings on hand. Let the depth of the front of these frames or boxes, be about eighteen inches, that of the back two feet; and width two feet and a half. If these be boxes, having bottoms, they must be perforated, to allow of a constant communication, on account of the draining off or admission of moisture, with the external soil. To these glass frame tops, opening by hinges should be provided.

Prepare also a mixture composed of rather more than one half, or nearly two-thirds, of *well rotted** stable or other manure, and the rest of a *light dry mould*, sufficient in quantity to fill the frames, box or boxes, to the depth, of from twelve to fourteen inches. Place these on the ground where they are intended to remain, in a position facing the sun.

The trees intended for this use, cut into pieces of two, or two and a half inches, or always of such lengths as to have each at least one bud, which should be near the end.† In the frames or boxes

* Some have said *fresh manure;* though in this case, they always allow sufficient time for its partial decomposition. It is proper to observe this, since it has been said that all *fresh* manure is poison to the mulberry.

† It has been recommended, previous to planting of the cutting, to take a sharp knife, and to cut a slice off the lower end of about three-fourths of an inch below the bud, on two sides, somewhat in the shape of the bowl of a pen. The advantage of this, however, appears to be doubtful.

containing the mixture already described, *about the first of March*, stick these cuttings, with the bud always uppermost and turned towards the south, but the whole cutting inclined with its head towards the north, at an angle of about forty-five degrees. Place them in rows about half an inch asunder, and at about the same distance in each row; or in such wise that the one shall not touch the other. Press the earth around them with the finger and thumb, covering over the bud about the fourth of an inch.*

On mild warm days, open the glass tops to admit air; but on the approach of frost, especially at night, close the glasses, and cover with matting or other protection. Or rather cover with mattings every evening before sunset, and keep them on next day, until the sun has attained considerable power. To prevent the escape of the heat of the bed from the sides, let a few inches of horse manure be placed around them. Two or three times a week, just before putting on the matting for the evening, let the bed be gently watered with water that has been previously exposed for a day or two to the sun. And when the plants come up and begin to put forth leaves, some plaster of Paris should be sprinkled over them.

From the first to the middle of May, the plants will be from four to eight inches high; and may then be transplanted to the place where they are intended to grow. For this purpose, on ground previously prepared as already directed, with the plough describe parallel rows *three feet asunder*, on each of which let holes, for the reception of the plants, be made one foot apart. With a transplanting trowel,

* It has been customary with some to leave the tip of the bud exposed; but subsequent experience has proved the advantage of the method prescribed. A hand machine, with a cutter and lever, has recently been prepared, and is for sale at the seed store of Messrs. Landreths in this city, with which thousands can be cut clean off with one stroke each. Its price is moderate, and it is extremely useful and convenient for the cultivator.

if possible soon after a rain, take the plants up carefully, with as much earth as possible attached to the roots. Insert these in the cavities prepared, the earth drawn around, press about them with the finger and thumb. Water them for two weeks daily, especially if the weather be dry; or until the plants give evidence of having freely commenced drawing their sustenance from the soil. If the whole of this be attended to, very general success and with few failures will be the consequence, and the plants will grow, during the same season, from four to six feet, and will ripen their wood so that the ensuing winter will not injure them.

The advantages resulting from the process of previously starting the cuttings in hot beds, are several and self-evident. By this means the culturist can insure to his young trees at least four weeks' longer growth in the first season. One bud by this means only is necessary, but in other cases two, which alone is a saving of half the expense in trees. The certainty of success as to each cutting is by this method much greater. Watering the whole when necessary, is by the contracted space they occupy much facilitated; and by this forwarding process, the young plants get such a start, that the weeds, which soon after spring up in prodigious numbers, cannot so seriously injure them.

2. Cuttings: method, 2. *By open cultivation without previous budding.* It is strongly asserted by some that two buds instead of one are necessary on each cutting whenever planted in open culture. For this let the ground be previously prepared with well rotted barn-yard or other stable manure; or in the want of it, with a mixture of ashes with fine mould, in the proportion of 150 bushels of the former to four loads of the latter to the acre. Having plenty of this or other suitable compost, manure broadcast, otherwise in the furrow, or even in the dibble, as is sometimes done for corn. After ploughing and harrowing strike off furrows, *north* and *south*, three feet

asunder, in which, one foot apart, and at an angle of forty-five degrees, as before, the heads pointed to the north, place *about the last week of April* the cuttings, one inch under the earth, with the upper bud facing the south. Draw the earth around the cutting so as to cover the bud about one quarter of an inch, and press the earth tightly around it. Water them for a few days, if there be no rain. As the sprouts appear, let the hoe draw some mould carefully round them, so as to give the roots depth of soil for their nutriment. Let the weeds be kept down, and the ground in all the above cases be kept frequently turned over, and fresh; and a good crop of trees may be insured.

By the frequent use of the cultivator, all grass and weeds between the rows should be effectually kept down. To keep the plants clean, and the ground well stirred and mellow is highly necessary till the first of August; after which the ground should not be stirred, and the trees should be left to ripen their wood. Plaster of Paris in the proportion of one bushel to the acre may be strewed over the plants when they are first forming their leaves whilst the dew is on them.

Fig. 2.

3. LAYERS: method 3. *Layering by the whole tree*, without branches. Trees are either layered by the whole tree, or by first taking off the lateral branches, and then layering each separately; the latter plan is preferable; since it allows sufficient room for the young shoots to grow.

For this purpose let the ground be duly prepared and pulverized by ploughing, harrowing, and if necessary, rolling; and manure, at least in the drill, with the compost already mentioned or slaked ashes. *About the last week of April*, run a plough or cultivator through the land, as if for corn, in parallel lines, three feet asunder; and let each furrow be three inches deep. One person lays the tree in a horizontal position in this furrow; the root of one plant being placed at the top of the one preceding it, and proceeds thus to the end of the line. Another follows him with a hoe, and draws the earth over the prostrate plant, covering it with mould to the depth of from one to two inches; though care should be taken not to bury it too deep. Wherever the furrow is not of depth sufficient to admit of covering the root or thicker part of the tree to that extent, with the hoe deepen the furrow below the root. In covering the root and main stem, lightly press down the earth with the flat part of the hoe, so as to cause the earth to adhere to both. And, in covering, draw into the furrow none but the well pulverized mould, that nothing should impede the ascent of the young leaflet. A little additional care employed here, will be well repaid in the improvement of the crop. Nothing can be more simple than this process. An additional advantage would be gained by previously steeping, for twenty-four hours, the trees in pure water. The roots and stems being thus all planted, proceed in all respects with the lateral branches in the same manner.

4. LAYERS: method 4. *Layering by sections* deserves the attention of culturists. Cut the tree into pieces of from twelve to fifteen inches; and having prepared the soil *at the same season* as already di-

rected, place these sections in the plough trace in such a manner that there will be a piece of the plant alternating with a space of equal length intervening between it and the next section. The intention of this is to admit more freely the sun and air between the plants, and also to favour the growth of the offshoots or branches; for these by the last method will be, from the closeness of the trees, few, compared with the number of buds which otherwise would produce a plant.

When the morus multicaulis is planted by layers, a tree does not always proceed from each bud. The buds, it is true, will frequently all put forth, but soon some one will exhibit greater vigour than the rest, and its growth will be rapid; but the next shoot or shoots will probably dwindle or dry up. The last method of planting layers is said to obviate this difficulty, as the several shoots, in their possession of vital power, are more on an equilibrium, and is, therefore, on the whole to be preferred. Of the two methods of preparing and planting cuttings, that of previously budding them is said to be much the better, though some prefer the latter. The last spring, cuttings planted without previously springing them nearly all failed, while layers were successful. But this was attributed to the unusual dryness of the season, and the want of skill among noviciates in the art, who did not understand many of their peculiarities and wants.

SUBSTITUTES FOR THE MULBERRY TREE, in the rearing of silk worms, have been long and anxiously sought. It has for some time been an opinion that the mulberry leaf was the only food on which the silk worm would subsist; but experience has proved otherwise. Among these substitutes, we find the *Maclura auruntiaca* of Nuttal; the *scorzonera of Willdenow;* the *tragopogon;* and the *lactuca sativa.*

The MACLURA, or OSAGE ORANGE, it is said, affords a good substitute for the mulberry, and will make excellent cocoons. This is a spreading deciduous tree, and at maturity is from twenty to thirty feet high, with a yellow axillary berry, the size of an orange, but not so succulent, though said to be agreeable when fully ripe. It was originally found

on the banks of the little Missouri or Washita river; also on those of the Red river in Louisiana, and of the Arkansa river in the Arkansa Territory. It is rapidly spreading over the south-west; and is a valuable tree for hedges as well as for ornamental variety. It begins to find a place in our nurseries, and will soon be generally known on account of its beauty.

The SCORZONERA, or VIPER GRASS, from scurzon, Sp. viper, on account of its being considered a certain remedy for the bite of that reptile; an attribute, however, which we much question, as few plants used for food possess such active qualities, unless we may suppose the roots contain medicinal properties not found in the tops, which is sometimes the case; and even such roots with particular preparation become safely edible.

The TRAGOPOGON PORRIFOLIUM, or *salsafy*, is well known in our gardens, as an esculent root, resembling in its habits, carrots, parsnips, &c. That a complete substitute for the mulberry had been found out, was recently announced, and from it, doubtless, the discoverer, from the supposition that it contained both a cheaper and better food for the silk worm, expected fame and wealth. It was ultimately ascertained that this important secret for supplanting the morus tribe, was no other than *salsafy!* The secret, however, died in the act of revealment. We hear no more of it.

The LACTUCA SATIVA, or *garden lettuce* has, in several of its species, been long known, as affording leaves on which the silk worms will feed. Cocoons have been made from them, as well as from the leaves of the trees already named. But they have been used either for amusement, experiment, or when other more natural and agreeable pabulum failed. The latter is probably the poorest of the substitutes known. Many others, may, no doubt, be in time discovered; but it is not probable that any herb or leaf, other than that of the mulberry, will ever be valuable for the silk culture. Though these substitutes have partially succeeded in the production of silk, yet not in a single instance, so far as known, of good quality, and therefore the use of them can by no means be recommended. RICE FLOUR is said to be used in China for silk; but in this country were it employed for this purpose, it would soon become scarce and dear. In short, no food can be supplied in equal abundance, nor so well adapted to fill the silk-secretors of the caterpillar, as that which has already been considered to be its legitimate and peculiar property. Other varieties of silk-secreting caterpillars consuming food of a different description may yet be discovered. It is said that in the Brazils, a caterpillar is found spinning its cocoons in the woods, from which the natives make silk. But we have no well authenticated accounts either of the worm, or of the tree on which it feeds.

There are several other kinds of substitutes, as for example the leaves of the *willow*, or of the *rose tree*; but the above are the principal now used. In England experiments have been made on an extensive scale to discover substitutes for the mulberry. Among these the succulent buds of blackberries or the young leaves were offered to the worms and eaten greedily by them. The elm, the sweet cowslip, and the primrose were presented with equal success; but when subsequently the mulberry leaf was offered, all the substitutes were instantly deserted, and their

preference for the food that nature, not art, ever designed for them was immediately decisive; nor could they afterwards be induced to taste the leaves which before they had greedily devoured. The leaves of lettuce and spinach were those they would afterwards taste. No flower or leaf of a roseate hue could they be made to approach.

These remarks we close with observing that those who seek for substitutes may, it is true, gratify useless curiosity, but will never thereby either benefit the public, or increase the quantity of silk.

CHAPTER V.

MULBERRY LEAVES: LEAF-SELLING: MULBERRY TREE-RENTING: LEAF-MARKET: STATISTICS.

1. Analysis of the mulberry leaf. All subsequent writers appear to be indebted to Count Dandolo for information on this point; but whilst they have added nothing new on the subject, they have deprived us of many remarks of practical consequence which may be considered as a comment on the count's important text, the *analysis of the mulberry leaf.**

"There are *five* different substances in the mul-

* A recent author on the "Mulberry and Silk Worm," detailing his experience, commences by decrying all published works as translations of foreign authors or compilations not adapted to our country. But having acquitted himself of this difficulty in his path, he at once takes up Count Dandolo and other authorities, and having darkened what they made clear, and confused what they had simplified—having minced the most important intelligence, and left those subjects doubtful where others had rendered them lucid and well defined, he suddenly leaves his readers in the mists of conjecture, without a new idea, an improvement, or any experience of which it was not in the power of every one who chose to take up any other book but his own to obtain more correct and definite intelligence. Having left his subject in "confusion worse confounded," he performs one redeeming act, by fixing upon it a price so outrageously enormous, that it is not likely to do immense injury by its circulation. To foreign authors, and to the good sense of our able and industrious fellow-citizens in correcting and improving them, we owe every thing we know on the silk culture.

berry; 1. *The solid or fibrous substance.* 2. *The colouring matter.* 3. *Water.* 4. *The saccharine substance.* 5. And *the resinous substance.*

"The fibrous substance, the colouring matter, and the water, excepting that which composes the body of the silk worm, cannot be said to be nutritive to that insect. The saccharine matter is that which nourishes the insect, that enlarges it, and forms its animal substance. The resinous substance is that which, separating itself gradually from the leaf, and attracted by the animal organization, accumulates, clears itself, and insensibly fills the two reservoirs, or silk vessels, which form the integral parts of the silk worm. According to the different proportions of the elements which compose the leaf, it follows that cases may occur, in which *a greater weight of leaf may yield less that is useful* to the silk worm.

"Thus the *leaf of the black mulberry*, hard, harsh and tough, produces *abundant silk*, the thread of which is very *strong, but coarse.* The *white mulberry leaf* of the tree planted in high lands, exposed to cold dry winds, and in light soil, *produces a large quantity of strong silk, of the purest and finest quality.* The *leaf of the same tree*, planted in damp situations, in low grounds, or in a stiff soil, *produces less silk, and of a quality less pure and fine.* The less nutritive substance the leaf contains, the more leaves must the silk worm consume to complete its development. The result must, therefore, be, that the silk worm which consumes a large quantity of leaves that are not nutritive, must be more fatigued, and more liable to disease, than the insect that eats a smaller proportion of more nutritive leaves. The same may be said of those leaves which, containing a sufficiency of nutritive matter, contain little resinous substance; in this case the insects would thrive and grow, but probably would not produce either a thick or strong cocoon proportion ate to the weight of the worm."

The count, however, does not intend us to under-

stand this without some limitation, as appears from the following remark: "the quality of the silk does not *solely* depend on the food, but also on the degree of temperature in which the silk worm has been reared." And soon after, he expresses himself thus, "notwithstanding all this, my experiments prove, that all things balanced, the qualities of the soil produce but a very slight difference on the *quality* of the leaf: that which will appear most evident is, that the principal influential cause of the fineness of the silk is the degree of temperature in which the silk worm is reared." To which we shall take the liberty to add, with the risk of little contradiction on the subject, lastly, *to the care with* which the little spinners are treated throughout the whole of their interesting economy.*

2. STATE OF LEAVES PROPER FOR FEEDING. Notwithstanding all silk-growers that have favoured us with the result of their experience, have recommended the feeding with *dry leaves*, or *leaves free from both dew and rain*, two articles appeared in the September number of the Silk Culturist of 1837 affirming

* "The following is the result of my experiments on the leaves of the grafted mulberry tree.

"1. One hundred ounces of leaves nearly ripe, picked on the same day from a Tuscany mulberry tree, produced *thirty ounces* (dry leaves) after dessication.

"2. One hundred ounces of the leaves of the giazzola produced *thirty-one ounces* and a half.

"3. One hundred ounces of the double-leaved mulberry produced *thirty-six ounces.*

"4. There are few ripe leaves of different trees which contain so little liquid as those of the mulberry when ripe; while on the contrary, the young leaf of this tree contains much liquid.

"5. One hundred ounces of the young leaves, such as are given to the silk worm in the first age, weigh less than *twenty-one ounces* when dried; thus it is evident, they contain almost four-fifths of water. This abundance of liquid accounts for the very great evaporation that takes place in the body of the young silk worm, in the first and second age." Id.

It is however a fact that some writers among us recommend leaves partially wilted and dry, while others affirm that they may be washed, the water wrung out, and then given to the worms.

that leaves wet with either were innoxious to the insect, and not prejudicial to the cocoon. Nothing, however, can be more contrary to the advice generally given us on this subject. We need not go far to find precepts of this nature in Count Dandolo; they run throughout his whole volume, and form a prominent article of his creed. One is now immediately before us, "*These insects would be injured by eating leaves moist with either dew or rain*," p. 33. "*The stripping of the leaves should not be begun before the disappearance of the dew, and ought to be concluded before the setting of the sun—it is all-important to have always a supply of dry leaves.*" Count de Hazzi, p. 65 and 67. "*The preservation of the health of silk worms, depends essentially on the leaves being perfectly dry when given to them. Wet leaves invariably produce a diarrhœa.*" Manual published by order of Congress 1828, p. 122. It would be needless to multiply authorities on this topic; they are everywhere, except in the two articles already mentioned in the Silk Culturist.

But there are other accidents that may render a mulberry leaf unsuitable to the insect. "The worst leaf that can be given to the silk worm, and which always injures it, is that which is covered with what is termed *manna*, that arises from the diseased state of the tree. The *blighted or rust-spotted leaves* do not injure. The worm will eat this leaf, carefully avoiding the spots."*

3. Preserving leaves. Hence to avoid these accidents, and to supply a resource for rainy days, a stock should always be kept on hand sufficient for two or three days; during which they may be kept without prejudice in cool places, sheltered from the light, but not too dry; such as cellars, storehouses,

* Dandolo, p. 33. "Rusty leaves have not this inconvenience, because the worms eat only the healthy portion." C. de Hazzi, p. 67. "Even when leaves become mouldy before being gathered, we need not regret it, because the worm eats only of it what is uninfected." Morin, p. 27.

brick floors, &c. They would lose their freshness in too dry a place and might rot in one too damp. Separate with care the wet leaves, and those affected by the secretion called *manna ;** dry the former ; the latter reject. They should not be heaped up too much together, nor any change of temperature suffered in the leaf-store, such as to promote fermentation, to which they will be liable when gathered in very warm weather, or too long left in a state of compression in bags, panniers, or baskets. On a dry and clean brick pavement, turn them frequently to new and dry parts of the floor, and expose them to the action of the air. Count de Hazzi says, "spread them in parcels on a clean linen cloth in a dry room, stir them often, with a rake or fork ; shake the cloth, and the leaves will soon dry. Dusty leaves must be cleansed with clean linen."† If the signs of the weather be watched with ordinary vigilance, much trouble, however, of this kind may be avoided.

4. Mode of gathering the leaves. Count Verri recommends to pass the hands from the lower parts of a branch to the top, and to strip the tree of its leaves *upwards*, not *downwards*, as the latter mode would injure the buds. This should be particularly enjoined on children and on others employed in picking. In short, the whole process requires caution to prevent the trees, especially when young, from receiving injury. Nature evidently has not intended that they should be stripped violently of their

* The manna is a disease which seldom affects the mulberry in this climate, but the information may, notwithstanding, be of great importance.

† The better way at least with the leaves of the morus multicaulis is to wash leaves which become dusty, and after wringing out the surplus water, as a washerwoman would wring a cloth, let them remain thinly scattered in a shady dry place till they become dry of the excess of water. From experiments hereafter to be adverted to, it will be seen that *dried* leaves are used in some places, by preparing them in the fall and feeding the young worms with them before the tender leaflets have been sufficiently matured in the spring. Hence we conclude that if the culled leaves are properly preserved from *heating, moulding, &c.*, what is called wilting will not injure them.

foliage. In the event of having hedges, orchards or other plantations, begin by pulling the leaves of the hedges; then proceed to the young trees, when it is generally prescribed to strip each completely, for, if any leaves remain on the branches, they attract the sap, whilst the naked branches are incompletely nourished.*

5. Repeated defoliations. On this subject

* So far as this inquiry relates to the *multicaulis*, it may be further observed, that the leaves must be plucked carefully so as not to injure the bud; for the plant is now of such value that one bud more or less makes a difference with the purchaser; as it is well known that each bud will produce a tree when properly planted and cultivated. It is generally thought too that leaves perform functions for vegetables analogous to that of lungs for animals. Hence it is recommended not to strip the multicaulis of all its leaves during the season, at least, of its growth. Whilst the tree commands a high price in the market, not more than one half of the leaves should be taken. In the course of a few years, when the plant is extensively grown, and its value diminished, it will be allowable to cut it down as wanted, and pass stalk, limbs, and leaves through a cutting machine into the hurdles. To obviate all doubts under present circumstances on this subject, in the event of wishing to raise more crops of silk during any summer than one, the dilemma may be solved by feeding the second or any successive crops, from different lots of trees kept for that purpose on the same estate.

All climbing on *young* trees must be avoided. In this case, the use of a rolling or wheeling ladder is recommended. It consists of two parts; a wheelbarrow, the legs of which are to be from seven to eight feet long, straight, somewhat projecting beyond the wheel, and connected by four cross sticks; and a ladder six feet long, which is attached to the wheelbarrow by a fourth cross stick. With this apparatus, a single man is able to carry several bags of leaves. The ends at either extremity must be pointed with iron. It forms when only *half displayed* a double ladder in the form of a triangle, resting on the ground, from its vertex at the cross sticks, the wheel of course being on one side, then suspended some inches above the ground. When *opened out* and fully extended, it is a ladder of from twelve to thirteen feet long. The leaf-bags used with this apparatus must be hooped, so as to remain open, and ought to have a hook to be hung on the branches; and care must be taken that the leaves, to keep them free from dust, be not emptied on the ground. When conveyed to the wheelbarrow or other vehicle they should be kept sheltered from the sun. For hedge forms and shrub plantations, as for the *multicaulis*, much of this trouble and expense is unnecessary. Yet light wheelbarrows with long deep bodies, or bodies with outward and obliquely projecting railing, will be found to be preferable to a heavy cart, in transporting leaves to the cocoonery or leaf-store.

Count Dandolo says, "the mulberry tree should only be stripped once a year, and that crop should be gathered so as to allow time for the leaves to shoot again before the cold weather, otherwise the tree would shortly die." We have here, however, to remember, that the count's precept had no reference to the superior energy of the vegetative principle of the multicaulis; and that frequently what is an orthodox canon in European agriculture, is nugatory in this climate; we must travel round half the globe before we find its like within the same parallels of latitude; and when there, we shall be, as here, in the land of silk. For the mulberry, multicaulis, and silk, China is the only American pattern. It is proper to hear another witness on the other side of the question.

During the present year, experiments have been made in feeding silk worms, and gathering the foliage of the Chinese mulberry, several times, during the season of feeding; but what is allowable with the white mulberry is inadmissible with the exotic. It should never be denuded as the other species are;—never more than one-third when young, or one-half when old. That this practice is adopted in China, is abundantly evident from a volume of splendid paintings just received, from a gentleman who has for years been conversant with that country. It appears from these paintings, that while feeding, and depriving the plants of foliage, the topmost shoots must be carefully preserved; but when feeding is over, it is then proper to nip off the leading shoots to promote the formation of wood, and at the close of the season *head down* the plant, the stump or root of which in our latitude is to be slightly covered with earth during the winter.

6. PROVISIONS FOR EARLY SUPPLY OF LEAVES. It is generally by no means advisable to admit the hatching of the insects until the early spring vegetation of the mulberry is sufficiently advanced to insure a continued supply of the leaf; in which case no

earlier resource procured artificially is desirable. The climates in this country, in which the return of these seasons may be calculated on with tolerable certainty, may be said to be anywhere to the south of the fortieth degree of latitude. To the north of this parallel extraordinary returns, in the spring season, of unseasonable frosts, occasionally exist, retarding or checking the movements of the agriculturist. Under these circumstances, it would not be otherwise than provident to be ready to countervail these contingencies by a secondary resource obtained artificially. To accomplish this, there are three methods, one by the green leaf, and two by the dry.

First method: or by the green leaf. Let a mulberry hedge be provided in a warm situation, having a southern exposure, and on the north and north-western extremities, well protected, by buildings, plantations or woods. Early in the spring, cover the hedge, with platted straw or matting, to protect it from the frost by night. Or, as the worms in their first age consume but little, a garden border will afford dimensions sufficient for the purpose. Again, we may sow the seed broad-cast or in drills, in a forcing border or hot bed, and thus obtain, to meet the first wants of the insect, an early resource which would be valuable in the event of temporary disappointment of supply in the ordinary way.

Second method: or by the dry leaf. This is accomplished simply by carefully drying and preserving the leaves of the early part of autumn before they begin to fall. It will be requisite to soak them in pure water, so as to restore to them nearly the same degree of moisture they had on the tree, and afterwards to dry them with clean linen cloth, before they are distributed to the young family in the spring.

Third method: by leaf powder. The leaves for this purpose towards the close of summer may be taken from the tree, and dried so effectually as to admit of being reduced to a fine powder, and afterwards preserved during the winter. In the spring,

after gently sprinkling with water as much of this powder as may be wanted, allow it slightly to macerate or acquire general moisture ; when if given to the early hatch, it will be found to attack this powder with an avidity not perceptibly differing from that with which it would consume the early leaf.

§ 2. *Renting of trees or selling of leaves.* Of the "*division of labour,*" in the parcelling out of industry in the mass, in a kind of retail manipulation, we, proud mortals, sometimes boast, as if it were peculiar to civilized society, and therefore give the term a sort of dignity, by heading with it whole chapters on "political economy," as if that too were our exclusive property ; without reflecting that both the one and the other are carried out, even by insect tribes, in all their beautiful development. There is not an art, a fabric, a machine, or an edifice but what exemplifies it. The painter, the artist, the sculptor, the maker of a penknife or even of a pin, each implies a little host of dependent operatives in his rear ; and thus what would be an impracticability to one, becomes an amusement when parcelled out in social industry. And why should "*silk*" either in the whole extent of this term, or in any part of it, be supposed to require any more difficult manipulation. Let us contemplate, for a moment, the wide surface it covers. Here is a *leaf!* and we see nothing but it, and its kindred leaves of the mulberry tree—but there is a silken shawl worn by a queen ! What metamorphosis has affected this ? Ovid, himself, with all his imaginative powers, must yield to this : his was fancy, ours is reality : the leaves of a tree are the silken shawl on the shoulders of a queen ! ! But what has accomplished all this ? *The division of labour !* Ask the *proprietor* of the orchard ; the *horticulturist* that raised the tree ; the *individual* that culled the leaves ; the *one* that ministers sustenance to an insect that boasts of nothing, but performs wonders, inhabiting a building furnished with an apparatus both made by *others ; another* that

patiently waits on the reel, or the *multitudes* attending the filature; the *several machinists* in wood and iron; the *many* engaged in throwsting, dyeing, weaving; the *merchant*, and his *carriers* by land or sea to the *retail dealer*, the *maker of the shawl;* and lastly, though not least, the *wondrous insect*, without whose toil all the rest were vain; and then the "*unknown something*" that has diffused, if not inspired industry throughout the whole. In this way, and in no other, we arrive from the mulberry leaf to the silken shawl on the shoulders of a queen. Could all this be accomplished by one?—Impossible. Thus what is a mountain to one, is sportive recreation when partitioned out to the many; and thus by the division of labour a toil becomes a pleasure.

But is the division of labour the child of man's inventive ingenuity? We could give many proofs, would our limits allow, to show that this is by no means always the case. Sometimes it has cost mankind whole centuries to find out what, when seen, we all wonder was not for ages before discovered to be the most simple of all contrivances. Rather then let it be ranked as the creature of Providence, with which if we co-operate, we shall be a blessing to the world.

Even in the production and manufacture of silk, strange to say, there are several parts, that we concede immediately should be the subjects of the division of labour; whilst there are others, that we have not yet, in this country, an adequate idea of the benefits that would result to society were they equally distributed. Often to him that supplies the land for the culture of the tree, it would be an inconvenience to attend to the production of silk. To another that grows the trees merely for sale, the tons of leaves that fall in autumn merely to manure the earth that might be silk to enrich the nation, are, for the want of the division of labour, a serious loss. To a family having only partial employment, to which it would be, on account of the avocation of one demanding a city residence, an inconvenience to remove to an orchard, or

to a situation in the country, merely to afford employment to the minor branches of the family, the establishment of a *leaf-market in cities*, and the possibility of rearing silk-worms, and producing and reeling silk in the otherwise unemployed apartments of a partially occupied house, would be an incalculable benefit. By which means too, industry might be afforded to thousands of the young, old, infirm, women, children, and others incapable of hard labour, that inhabit all our large and populous cities, who thus, instead of being idle or dissipated, would in enriching themselves as surely enrich the nation.

Let all then that have both land and trees, and are willing to sustain the amusing toil of five weeks in the cocoonery, comprise this much of the general production in their individual enterprise. As for the rest, we must repair to France, to Italy, to Broosa, or to Turkey and Persia generally for an example; and we shall there find, that in many cases, the concern of growing trees or leaves is one thing, and that of producing silk another;* that the one is the business of the country, the other of the town: and that the connexion between them is established by a *leaf-market*. The agriculturist there attends to avocations peculiar to the former, the manufacturer to that which is compatible with others he may have in the latter. Leaves there inhabit the forest until they visit the market, where silk worms are citizens, spare apartments are cocooneries, and towns or cities are the busy hives of domestic industry.†

* Several years since, a farmer in a vicinity not far from Mansfield, (Conn.) purchased a farm on which were standing twelve mulberry trees of full growth. Knowing nothing of the business of making silk, he supposed them to be of no more than the ordinary value of forest trees for fuel. A neighbour, however, soon called upon him, and agreed to pay him twelve dollars annually for the privilege of picking the leaves. The farmer, to his astonishment, found that the twelve mulberry trees were as good to him as $200 at six per cent. interest.

† We do not wish to be understood as saying that the two branches of business are incompatible. We think quite otherwise, more especially in this country; but we do advocate the system of a mulberry leaf

We learn that the friend of a gentleman, now resident in New York, in the year 1807, invited him "to visit a plantation of mulberry trees, which he had just planted at Fontaine, about fifteen miles from Lyons. Here sixty French acres, (about seventy-five English) had just been set out with trees of the mulberry, at the rate of 200 trees to the French acre. About six years afterwards he was again invited to visit the plantation, at the time the leaves were fit for gathering; and he there found that the leaves of the whole plantation, or of about 10,000 trees, had just been sold on the trees to the gatherers, for *one franc for each tree*, or about $2000 for the whole.

"These gatherers, (*an example of the division of labour*,) are another class, who come at times from remote distances with their whole families in wagons, with cooking utensils and provisions, with ample means for the purchase of the leaves. Shantees or sheds only, for their accommodation, are provided by the owner. It is particularly understood, however, that *the leaves at the tip end of every twig are always to be preserved*, to draw the sap and preserve the life and vigour of the tree.

"Four years after he was invited to renew his visit, when he found that the leaves had been sold on the trees *for three francs per tree*. He renewed his visit about seven years after, or seventeen years from the first formation of the plantation, and he then found that the leaves had been sold on all the trees, *for five francs per tree*, or for about $10,000 for the whole; and that this same quantity, or more would be annually produced for a long course of years."

Granting that these trees were three years old when planted, and consequently nine years old from the seed at the *first visit*, thirteen years old at the second, and twenty years old at the third; from the whole of this account we learn as follows: 1. That in France

market, as being especially beneficial to citizens in moderate circumstances without land.

the leaves of the *white* mulberry of nine years old from the seed, are worth one franc, about twenty cents per tree; at thirteen years old, sixty cents on the average per tree; and at twenty years, or of full growth as sometimes said, at $1 per tree. 2. Here are seventy-five acres, and they yield in the sixth year after planting $2000, or $26.66 per acre: of the intermediate years we are told nothing, but in the tenth, they yield $6000, or $80 per acre. We now, by the account arrive at the seventeenth year of the appropriation of these seventy-five acres to a plantation, when they yield $10,000, or $133.33 per acre for a crop of leaves only! How valuable then are leaves, if of the mulberry, even without fruit, without roots. To how many other kinds of crop* could an acre be devoted, and yield a profit equal to an income from mere leaves? 3. We are told that this rate of profit the trees would maintain for "*a course of years*," we are not told, however, why such an indefinite expression is used. The reason, however, is self-evident, and stands thus; if the trees were the *grafted* mulberry, chiefly used in France, it is true that they would thus hold out only for a "*course of years*," probably not more than five. This is all the benefit of *grafting*, altering the course of nature by art. For the sake of some improvement in quality or quantity for a short time, it is rapid destruction; whereas the *natural* not *artificial* mulberry, will improve, *proprio Marte*, both in quantity and quality, *as it grows older*, and has been found exuberant in produce, and in quality more excellent than its juniors at the venerable age of *three hundred years*. 4. Here are ten thousand *standard* trees on seventy-five acres: hence, in France, they plant standards at eighteen *square* feet between every four trees.†

* We might say from the vine; or from the beet, not to produce sugar, which requires machinery, but to fatten cattle; but this depends on circumstances, and right management; and this is not the place to explain.

† A writer in the Silk Culturist inquires, "Whether farmers cannot plant trees, and let them out to poor families to make silk on shares,

§ 3. *Leaf-Market.* We know that these are regularly established on the Continent, not only of Europe, but of Asia. Time and limits fail to give all the examples; that of Broosa is enough. There, on all the roads and avenues to the city we see mules, asses, camels, and other means of conveyance freighted with mulberry leaves to the leaf-market in Broosa. In the city itself, we see nearly every family, on the approach of the silk-raising season, on the move to clear, and to make ready for the labours of the silk worm, every spare apartment in the house. Two-thirds, three-fourths, or four-fifths of every dwelling is a cocoonery. And where is the difficulty? In the town there is the leaf-market every day; and in the house there are the worms, all the advantages of the town and country are combined, without the disturbance of other engagements, by the connecting link, the leaf-market.

And it is evident of what accommodation and advantage this would be to all parties. That to the *leaf-grower* admits of calculation. M. Bonafoux found that a journal of land of Piedmont (four-fifths of an acre) produced from *multicaulis cuttings** of the second year,† fifty quintals. That is about five-ninths of a pound of leaves to each; on the third year from the time the cuttings were set out, the same trees produced 100 quintals or more than one pound of

and thereby not only extend the culture of silk, and benefit themselves, but also afford a livelihood to those in their employ? The editor answers: "We have no hesitation in answering in the affirmative. There are few farms in this country that could not be fourfolded in value, by adopting this course; besides giving an opportunity to the industrious poor, not only to provide for the present wants of their families, but to lay up something in store for the day of adversity. The children of poor families might be profitably employed in picking the leaves, and thus contribute much towards their clothing and education. Multitudes of such children are, instead of this, running about the streets contracting habits of vice and immorality. We know of no better remedy than the one suggested by our correspondent."

* Set in rows two and a half feet asunder, and in the rows each tree one and a half feet apart; i. e., 11,537 cuttings to the English acre.

† A quintal is equal to 100 pounds. On the journal of land, at the rate mentioned of setting, there would be 9,229 cuttings or trees.

leaves each. And he estimated the maximum to which they would attain at 200 quintals, (about 25,000 pounds of leaves to the English acre,) or about two and two-thirds of a pound to each multicaulis tree; which at eighty cents* per quintal of 100 pounds, would be equal to $200 per acre to the *leaf-grower* from the multicaulis tree. M. Bonafoux further calculates that these 250 quintals of multicaulis leaves, would produce 312 pounds of reeled silk, which in this country would be, at least, worth $1560. Hence more than $1300 are to be gained on the 250 quintals grown in the *country*, by the families in *town* that take the trouble to attend the worms, and produce the silk.

We say then, on account of the thousands of women, children, aged, infirm, and otherwise unemployed people, inhabiting Philadelphia, New York, Baltimore, and all our large and populous cities, let a *leaf-market* be established in each, and let the farmers that have *the wisdom to enrich* their hedges, orchards and fields with the *wealth-giving tree*, be told to bring their leaves by the horse load, the wagon load, the boat load, or our very railroads will help them; and then every citizen that is tied by his duties to the town, but has hands to spare in his family, and apartments in his house not paying rent, will provide the worms, buy the leaves, and put all in requisition; and our streets, and our cities will be filled with the scenes of activity, marking out to all the way to industry, morality and wealth.

§ 4. *Statistics relative to the mulberry tree.* Both *theory* and *practice* have reference to statistical consequences. *Mere* theory often contemplates them, but without practice arrives at erroneous results. On the other hand, a career of practice entered on without previous inquiry of a statistical character,

* A quintal of leaves sometimes attains more than this in the leaf-markets of the continent; sixty-four cents per quintal, are not far from the average price.

must often lead into a dilemma or difficulty, easily avoided by competent information of this nature previously acquired; and when this is the legitimate proceed of the experience of the many, the eccentricity of extraordinary cases corrected by the more accurate report of the majority, we have, perhaps, as great an indemnity against either failure or inconvenience, in the development of our practical designs, as the nature of things can possibly admit.

So long as the silk, or any other business, is, in design, at a distance, statistics may be looked upon as something abstract, mathematical, dry or uninteresting; but precisely as we approach the bourne, where we are to have the object in our grasp, the case becomes altered, until statistics appear all-interesting, of immense consequence. Statistics, in short, in all things, are too little studied. Without them, theories, hypotheses, schemes and systems, in art, in science, or in political economy, may be multiplied numerous as the phantasms of the kaleidoscope. But begin with statistics, the true gauge and barometer of consequences, and theories, hypotheses, and schemes explode by the legion, and leave nothing but TRUTH in *alto-relievo.*

Relative to the silk business, no inquiry is more common, nor, perhaps, more proper, than what is the weight and value of raw silk which may be produced from one acre? But it is evident that this question involves several others, each of which must be answered or understood, before we can arrive at the correct solution of this important problem. As 1. What *weight* of cocoons will, on the average, yield one pound of raw silk? 2. How many silk worms, will, generally, produce this weight of cocoons? And this question implies at least three subordinate inquiries relative to the kind of silk worm employed, the manner with which it is attended, and the leaf with which it is fed. 3. What weight of mulberry leaves will sustain and bring to maturity this number of silk worms? This again is another question that

evidently subdivides into as many branches as there are species and varieties of the mulberry. 4. Then we arrive at another stage of the investigation, i. e. what weight of leaves will a mulberry tree or shrub, on the average, produce, at all ages, from a few months to twenty years; when, if it be the grafted mulberry it is said to be at its maximum yield: very different, however, will be the case, if it has not had its *natural* youth vitiated by the *artificial* device of man, worse than *vaccine inoculation.* And here, again to answer correctly, we must attend to several important distinctions; not only according to the several species and varieties of the mulberry, but also to the nature of the soil, which must either further or retard its growth. 5. How many such trees or shrubs will an acre contain; and finally, what weight of leaves on the average, in each case, will an acre yield? And this last inquiry depends on an almost unlimited variety of complex distances, that of between the rows in the acre, and between the trees in each row, as well as the distinction to be *primarily* entertained in the mind of the inquirer, relative to the species or variety of the silk-producing tree, and the soil that fertilizes it.

The wide extent of surface which these several questions, with their subordinate modifications, evidently cover, requires that the general inquiry, for distinction sake, be broken down into its proper component parts; and that no attempt be made to answer the whole, as some have done, *en masse;* and therefore, have left the mist, like that of the mock-sun in the sunless climes of Iceland, as thick at the end of their apparent scrutiny as where it began. We shall take up, in the course of this work, *seriatim*, the whole of these inquiries. But here, immediately after the mulberry, our subject is *leaves;* or the quantity of them in weight, which, *on the average*, according to its age, may be expected from one of each species or variety *principally* cultivated, or from one acre charged with its cultivation.

That the yield in *foliage* of a WHITE MULBERRY *standard* of twenty years old is from 150 to 200 pounds of leaves, is universally affirmed.* The doubt, then, as to the product of white mulberries, is not here, but relative to those of minor growth, on which egregious discrepancy, amongst different authors exists. Mr. Cobb tells us that M. d'Homergue† asserts‡ that a white mulberry of six years old, will produce thirty pounds of leaves! This assertion reappears in the first edition of Mr. Roberts' manual, and has been copied, with the following palpable contradiction in the second edition of that work. "The Editor of this§ manual, assumes the following: it being the best result at which his mind could arrive after the most careful examination of various authorities—that is, that a tree, as a standard, four years of age, well cultivated, will yield twenty pounds of foliage, that at six years of age, it will yield thirty pounds; and that if planted in hedge form, an acre of land will yield an amount of leaves, when six years

* Though even here, authors always forget to say, whether the twenty years be reckoned from the seed, or from the first introduction of the tree into the plantation of standards: an ambiguity which has frequently led into apparent contradiction. This appears to have been first affirmed by Mr. Bailiff Hout, of Manheim, in his memoir submitted to the Agricultural Society of the Grand Dutchy of Baden.

† We quote M. d'Homergue, whose book is in our hands, and whose residence is at our door, on the mulberry tree, because he is given as authority on this subject by several recent writers! We admit this very respectable writer as good authority on the *filature*. He is, on this branch of the business, quite *au fait*. But we have yet to be assured that he is a safe guide on some other branches of the silk culture, because his experience is quite limited, and he makes no pretension to any but one branch. From M. d'Homergue, however, we have received many attentions; and on the *Piedmontese reel* and *filature* some information, which we acknowledge with the kindest feelings. But when we see him quoted on the mulberry tree, as a practical man, we suspect that there can be no extensive experience among those who do so, since they demonstrate to us that they are unable to discriminate between what is *theory* and what *practice*.

‡ Page 40.

§ "This manual," first edition. "The manual." second edition, Baltimore, 1838.

of age, more than equal to the support of 540,000 worms: that is, he believes, that each tree at four years will yield four pounds of leaves, and at six years will yield seven pounds of leaves; and that its capacity to yield will increase by the time the hedge shall have attained its twentieth year, 100 per cent.!"* From the whole of this passage we are edified as follows: "each tree at four years old will yield four pounds of leaves," and in the former part of the paragraph it is said that a tree of the same age will produce "twenty pounds of leaves!" Again, "at six years it will yield seven pounds of leaves;" very true, since a few lines above we are informed that such a tree will yield thirty pounds of leaves! Should we endeavour to find a salvo to resolve this gross ambiguity, it must be from the phrase, "as a standard." The one tree then is four years old from the seed, the other four years from the time it became a standard by transplanting. Allow four years for this,† and the same for the tree of six years, and we then have, that a white mulberry tree of four years old from the seed, will yield four pounds of leaves; of six years, seven pounds; of eight years from the seed, twenty pounds; of ten years, thirty pounds.

But how far is this corroborated by other accounts? We find it stated by the same author,‡ that "one pound" (of silk) was produced from eight trees, (white mulberries) eight years old from the seed." Now, as it requires 100 pounds of white mulberry leaves to produce one pound of silk, it is evident that in this case, these eight trees bore 100 pounds of leaves, or twelve and a half, each. The preceding statement relative to a tree of the same age, was twenty pounds. The mean of the two respecting a white mulberry tree of eight years *from the seed*, therefore, is sixteen pounds of leaves.

* How extremely indefinite is all this. 100 per cent. on what? On the first, second, or on what other year's produce?

† See note, page 176.

‡ First edition, p. 32, col. 1.

We shall now quote another authority found on page 8, vol. I. of the Silk Grower.* "In one acre there are, 43,650 square feet. 1,210 trees six feet by six, on one acre; or 4,840 trees one and a half feet by six. *Each Italian mulberry tree, six years old, will produce six pounds of leaves.* Fifty pounds of leaves, (some say thirty-six) will feed 1,000 worms; 300 cocoons will weigh one pound; 3,000 cocoons (ten pounds) make one pound of silk. 30,000 trees, six years old, will produce 180,000 pounds of leaves. The above calculation is made on the *white mulberry.*"

From the whole of this evidence, we come to the conclusion, that a *white mulberry tree* of

Age.	lbs.
4 years from the seed will yield	4 of leaves.
6	7† ———
8	12† ———
10	20 ———
20	150 ———

Though this is deduced from the best accounts extant on this question, it can only be regarded, especially when difference of soil is considered, as an approximation, until the attention of the culturist is more particularly directed, to derive more accurate averages from well conducted experiments of this nature.

As to the product in *leaves* of the MORUS MULTICAULIS, it is stated in an article of the Silk Culturist‡ that 100 cuttings of the first year, i. e., *within a few months* of setting, yielded fifty-five pounds of leaves; and that 100 cuttings, started the year before, produced 150 pounds. That is, at the rate of between eight and nine ounces for the former, and one pound

* And therefore has passed the revision of the Messrs. Cheney.

† "Each tree at six years of age, with the best cultivation, will produce twelve pounds of leaves." Kenrick, p. 88. But Mr. Kenrick, in common with others, does not state whether this is six years from the seed or from planting. If the former, it is contradicted by several other accounts, but more consistent with them, if we are to understand it in the latter sense.

‡ December, 1835.

and a half for the latter. We have besides various other evidence relative to the same point, now before us, too voluminous to copy in detail.* The accounts as to first year's cutting vary, as for example; seven, eight, eight, nine, nine, twelve ounces; the mean of which is eight and five-sixths ounces. This compared with the first statement, fifty-five hundredths, or eight and four-fifths ounces, will fully warrant us in quoting that the average yield in leaves of a multicaulis cutting of the first year is above eight ounces or half a pound. But the mean of the evidence we have before us, relative to the weight of the leaves of layers of the first year, is fourteen and a half ounces. We may, therefore, safely quote, half a pound for the former, and three-quarters of a pound for the latter.

Amongst the several thousand pages, in the many volumes on the Silk Culture, that we have examined, there is very little of a statistical character, relative to the average product in leaves of a multicaulis tree of the *second year's growth;* and that little is extremely discrepant and dissatisfactory. Sufficient attention, it is evident, has not as yet been paid to this subject, though it constitutes an important element in calculations relative to the silk culture, without which they must be comparatively indefinite and vague. We are aware, indeed, of all that might be said concerning the variable productiveness of different soils and climates, but notwithstanding this, an *average*, a *mean*, does and must exist in this, *and in all things*, and this is all we aim at. It is true, that this cannot accurately be had except from a multitude of experiments; and until these can be made and their mean determined, we had rather have an approximate average than have none.

It was originally stated in the Northampton Courier, that from 100 multicaulis trees of the second year's

* See Silk Culturist, pp. 71. 76. 130. 157; vol. III. 35. Fessenden's Silk Manual, vol. I., p. 140; vol. II. p. 2.

growth 150 pounds of leaves were obtained; which is one and a half pounds per tree. This was afterwards copied into Fessenden's Silk Manual, vol. I. page 141; and also into the Silk Culturist, vol. I. page 71. Yet five pages after in the latter work we read, "14,000 Chinese plants on one acre of two years' growth would yield 35,000 pounds of foliage;" that is two and a half pounds per tree. We think that this latter statement is erroneous and presumptive; not merely because it differs from the former, but deals so much in round numbers, as to wear on the face of it the absence of actual experiment or calculation; and until better evidence can be adduced, we are inclined to say that a multicaulis tree of the second year's growth will produce, on the average of trees, soils, and climates, two pounds of leaves.

But what a wide leap have we from two pounds of leaves, or even from two and a half pounds on the second year, to fifteen pounds of foliage on the third year; yet at page 32 of the last edition (1838) of Mr. Roberts' Manual we read "we assume that *each* of these trees (multicaulis) at three years of age, if properly cultivated, and not despoiled of their limbs will yield fifteen pounds of foliage!" But how is this series to be accounted for, first year, one half or three-quarters of a pound of leaves; second year, two or two and a half pounds; third year, fifteen pounds. Mr. Cheney has somewhere intimated that the *ratio* of the increase of the multicaulis in successive years, is *geometrical*. But we have not mathematics sufficient to discover what geometrical ratio exists between three-quarters, two, and fifteen; and therefore refer the enigma to the experimental horticulturist to decipher. Were it allowable, however, to go on the principle of a geometrical ratio, until matter of fact could correct the series, we should say that the multicaulis of the *first* year's growth that produces half a pound of leaves, would on the *second* yield two pounds, and on the *third*, eight pounds; whilst another that yielded on the *first* year three-quarters of a pound,

would on the *second* produce two and a quarter pounds, and on the *third* nine pounds. And this, however, hypothetical it is at present, for want of facts clearly stated, must be, will eventually, perhaps, be found to be not far from the truth.

The inquiry relative to the yield of foliage per acre, whether of the morus alba, multicaulis, or of any other tree, admits of as many answers, as it is possible to divide, without injury to vegetation, an acre into rows, and the several distances from each other that it would be proper to set the trees in each row. A hundred inquiries of this kind will be met, once for all, by the following table, and any intermediate cases will be easily calculated. An acre, of course, we all know, is any piece of ground that contains exactly 4,840* *square* yards, or 43,560* *square* feet. In the following table fractions are rejected, and the nearest whole number taken.

Table showing the number of trees or plants in an acre according to the width of rows, and distances between trees or plants in each row.

Feet apart from row to row.	Number of feet distant from tree to tree in each row.									
	1	2	3	4	6	9	12	15	18	20
1	43560	21780	14520	10890	7260	4840	3630	2904	2420	2178
2	21780	10890	7260	5445	3630	2420	1815	1452	1210	1089
3	14520	7260	4840	3630	2420	1613	1210	968	806	726
4	10890	5445	3630	2722	1815	1210	907	726	605	544
6	7260	3630	2420	1815	1210	806	605	484	403	363
9	4840	2420	1613	1210	806	537	403	322	268	242
12	3630	1815	1210	907	605	403	302	242	201	181
15	2904	1452	968	726	484	322	242	193	161	145
18	2420	1210	806	605	403	268	201	161	134	121
20	2178	1089	726	544	363	242	181	145	121	108

* One acre $\times 4 \times 30\frac{1}{4} = 4840$; and $4840 \times 9 = 43560$

The use of this table will be readily perceived from an example or two. If we have an acre set with the morus alba six years old, three feet distant from one another in rows six feet asunder; it is seen by the above table that we have 2,420 such trees on the acre, which at seven pounds of leaves each will produce 16,940 pounds of leaves. And as 100 pounds of leaves of the Italian mulberry are equal to one pound of silk, we are warranted to expect from that acre 169 pounds of raw silk.

But, if the acre be set with the multicaulis of the second year's growth one foot distant as directed, from one another in rows three feet asunder; we shall have, according to the same table, 14,520 trees on the acre, which, at one and a half pounds of foliage each, will produce 21,780 pounds of leaves; and since of the multicaulis eighty pounds of leaves are equal to one pound of silk, we may expect from the acre 272 pounds of silk; or 103 pounds more than from the acre of the morus alba of six years' growth set as described.

PART III.

ON THE SILK WORM.

CHAPTER I.

ON THE SILK WORM, GENUS, SPECIES, VARIETIES.

THE silk worm, or *bombyx mori*,* is one of the various families† of CATERPILLARS, that pass through several transformations into their final state, the moth or butterfly. All such caterpillars are of the LEPIDOPTERA‡ ORDER§ of insects; and of these, all that have four wings in their moth or butterfly state are capable of producing silk.

Of insects generally, it is proper here to state, that when they issue from the egg, they are by naturalists called LARVA; but in common language, according to

* *Bombyx mori*, the silk worm of the mulberry tree; a proper distinction, since there are caterpillars producing silk from the cypress, fir, ash and oak, according to Pliny, D'Incarville and others.

† As the carpenter caterpillar, the goat-moth, earth-mason caterpillar, tent-maker, stone mason caterpillar, leaf-miner, bark-miner, gipsey-moth, tiger-moth, puss-moth, golden-tail moth, spinning caterpillar, silk worms of several varieties, &c.

‡ Λεπις, ιδος, scale, flake, and πτερον, wing; λεπιδοπτερα scale, or flake-winged.

§ One of the twelve orders of insects, viz.: 1. *Coleoptera*, from κολεος, a sheath, and πτερον, a wing, *sheath-winged*; as *beetles*, &c. 2. *Strepsiptera*, from στρεψις, a turning or folding, and πτερον, *folding-wings*; as *stylops*, *xenos*, &c. 3. *Dermaptera*, from δερμα, skin, leather, and πτερον, *leather-winged*, as *earwigs*, &c. 4. Orthoptera, from ορθος straight, and πτερον, *straight-winged*; as cockroaches, locusts, grasshoppers. 5. *Hemiptera*, from ημισυς, half, and πτερον, *half-winged*; as, field-bugs, cicada, water-boatmen, &c. 6. *Trichoptera*, from θριξ-τριχος, hair, and πτερον, *hair-winged*; as, the flies produced by the various kinds of caseworms. 7. *Lepidoptera*, as already described, *flake-winged*. 8. *Hymenoptera*, from υμην, a membrane, and πτερον, *membraneous-winged*; as bees, wasps.

the genus, species, &c. *caterpillar*, *grub*, or *maggot*.* Larvæ are remarkably small at first, but grow rapidly. Some larvæ have feet, others are without; none have wings, neither can they propagate. They feed voraciously on coarse substances, and as they increase in size, they cast their skin, three or four times; until finally they undergo a complete change of form, and with a few exceptions, cease to eat, and remain nearly motionless. When an insect, after this change, does not lose its legs, or continues to eat and move, it is commonly called a *nymph;* but when the inner skin of the larva is converted into a membranous or leathery covering, which wraps the insect closely up like a mummy, it is termed PUPA, from its resemblance to an infant in swaddling bands. From the pupæ of many of the butterflies appearing gilt as if with *gold*, the Greeks called them *chrysalides;* (CHRYSALIS in the singular;) and the Romans, for the same reason, *aureliæ;* and hence naturalists frequently call a *pupa*, *chrysalis* or *aurelia*, even when it is not gilt. Hence, *pupa*, *chrysalis* and *aurelia* are synonymous, and signify the same state. After a certain time, the insect which has remained in its pupa-case or *cocoon*, is gradually preparing for its final change, when it takes the form of a perfect insect. This state was called by Linnæus IMAGO, because the insect having thrown off its larva (mask) becomes a perfect *image* of its species. Of some this last portion of their existence is very short; others live through a

9. *Neuroptera*, from νευρον, a nerve, and πτερον, *nerve-winged;* as dragon-flies, antlions, ephemera, &c. 10. *Diptera*, from δις, twice, and πτερον, *two-winged*, as gnats, &c. 11. *Aphaniptera*, from αφανης, obscure, and πτερον, *obscure-winged*. 12. *Aptera*, from ἀ privative, and πτερον, without wings, or *wingless*, as mites, lice, &c.

* The distinction in common language, properly is, that *caterpillars* are produced from the eggs of moths or butterflies; *grubs*, from the eggs of beetles, bees, wasps, &c.; and *maggots*, which are without feet, from blow-flies, house-flies, cheese-flies, &c. Maggots are also sometimes called *worms;* but the common *earth-worm* is not a *larva*, nor is it by modern naturalists ranked amongst insects. It is properly a *reptile*, a creature that *creeps* but never *flies*.

year, and some exist even for longer periods. They then feed, at most, lightly, some not at all, but never increase in size. The chief object of that state is the reproduction of their species. The OVA are deposited, and then the greater number speedily die. Hence, such an insect exists in four distinct states; it is, 1. an *ovum;* 2. a *larva;* 3. a *chrysalis;* and, 4. the *imago,* butterfly or moth.

The CATERPILLAR is a cold-blooded insect; has no heart, but a substitute in a long tubular *dorsal-vessel* running along its back, and pulsating from twenty to 120 times a minute, by means rather of a lymph than blood, but performing a function analogous to the former. It has no brain; and the nerves, which are few, are called ganglions, from being united in little knobs. They breathe through spiracula, or air-orifices, the number of which varies according to their species. The spinning apparatus, usually consisting of two parts, is placed near the mouth,* which are a part of the silk bags, that in some caterpillars are long, in others comparatively short, but usually slender, floating vessels, containing a liquid gum. These bags are of different shapes, as well as lengths, but are generally convoluted sacks closed at one extremity, and opening at the spinneret, larger towards the middle, and smaller towards the head. Their length, as in the silk worm, is often several times that of the body; and the silk is ejected by a kind of peristaltic motion.†

* Other insects spin silk from the opposite extremity of the body. In the great water-beetle (Hydrophilus piceus) that extremity is furnished with two spinnerets with which it spins its egg-poueh. The larva of the myrmeleon spins a cocoon in a similar manner, but differs remarkably in having the silk secretor in the rectum. The web of the spider is also a kind of silk, singular for its extreme lightness and tenuity. It is the proceed of four anal spinerets which never vary in number.

† "Caterpillars have a long body, more or less cylindrical, which is formed in its length of *twelve membranous parallel rings;* which in the movements of the animal mutually contract and elongate They have uniformly a *scaly head,* of a substance similar to horn, provided with two strong jaws, formed like a saw, which are moved horizontally, and not upwards or downwards as in animals of red blood. They have never

The larva of the BOMBYX MORI, when full grown, seeks a place, as it were, of concealment, where it commences spinning its habitation; a protection as well for its present as for its future state, that of the pupa, to which it approaches, at once against the changes of the season and the attacks of its enemies. In this operation, it throws the liquid fluid or gum through the silk secretors, which are two orifices, passing from silk bags in its lower part, and extending, with many convolutions, to the other extremity of its body. These two apertures have been long supposed to be separated, and that each filament or fibre of silk was double; but recent investigation authorizes the inference that they unite at the point of contact with the atmosphere. These orifices are like wire drawing machines, which graduate the diameter of the fibre; and the gum bags are capable of discharging all their contents in the elaboration of the cocoon. The silk secretors of the caterpillar of the bombyx mori, are said to be provided with glands, by which the juices of the mulberry leaf are discussed and secreted, so as to supply the different organs without any admixture of other ingredients.* Without this,

fewer than eight feet, and never more than sixteen. The six first formed of a scaly substance similar to that of the head, are fixed under the three first rings and can neither be sensibly shortened nor lengthened. The others, whether two, four, six, eight, or ten in number, are flexible, and attached in pairs to the back part of the body, under their corresponding rings. These last legs are those which transport the animal. They are provided with little hooks, calculated to give it support in climbing. All the hinder legs disappear, of whatever kind the caterpillar may be, when it changes into a butterfly, and there remain only six. Caterpillars breathe by eighteen apertures, and situated nine on each side of the body. Each of these openings is considered as the termination of a particular windpipe. Some have a smooth skin, as the silk worm, others are rough; and some have a skin either partially or wholly of velvet; and others with hair or bristles of various colours. A great number of caterpillars have eyes, some of them are utterly blind, but they attain the power of vision when they become butterflies." Count Dandolo.

* According to Ramdohr, these secretors consist of two transparent membranes, between which flows a yellow, limpid jelly. The longer the secretors, the greater is the quantity of silk expended by the insect in the construction of its cocoon.

the silk would not be of the quality and texture in which it is found.

The same cause that makes a crab or lobster throw off its shell, compels the caterpillar, at stated times, to throw off its exuviæ. As it increases in size, its skin becomes rigid and tense. It is, to borrow a phrase, "hide-bound." Confined by a skin, which is destitute of any elasticity proportioned to the rapid increase of its dimensions, it becomes embarrassed, languid, rejects food, from partaking which it feels an increase of suffering; and making a few struggles, the old skin yields, and the regenerated larva disenthralled, swells into an enlarged size before the new envelope becomes of a hardness such as to resist its further growth. Whilst the new skin is acquiring the inelastic consistency of the one just rejected, the caterpillar eats with voracity. This, however, as before, is arrested, by the unyielding tension of its new suit, before it has acquired maturity; and hence the repeated transformations, or *moultings*, as they are called, to which it is subject, in its advance to the ultimate object and fruition of its being.

When the larva of the bombyx mori attains its full size, it ceases to eat, and instinctively* prepares a covering to protect it from the rain, and from either birds or insects that would otherwise devour it. For nature ordains it to work under trees; and it never changes its mode of operation whenever permitted to work without artificial control. In building a cocoon, it encloses itself in three coverings. 1. With a floss; 2. With silk; and 3. With gum, with which last, it lines the inside of the cocoon, except at one end, which it only partially closes, and that end is where it will have, from the position of its body,

* *Instinct* alone is a universe of wonders; who can adequately develope it!! Visigoths they must be, who never trace instinct to the exhaustless source of infinite and eternal intelligence. That which launches a planet through the illimitable void of æther, guides an insect over a leaf!! And shall this be done every day, and we never derive the inestimable inference?

neither inconvenience nor obstruction when the period arrives for it to make its egress.

The cocoon being constructed, according to the inimitable rules of insect art, the *larva* disengages itself of its fourth skin, and enters the *aurelia* or *chrysalis* state. A new state of existence is soon to be entered on. To this end, the insect taught by a wisdom that is inscrutable, but that can disseminate itself to an atom, throws off her skin, with the head and jaws attached to it; and the new skin immediately hardens into a leathery hide. This again, gives way to a new form, whilst the moth is gradually unfolding itself, and the wings, the legs, and the antennæ acquiring strength and firmness. In ten or twelve days, the chrysalis swells, bursts, and the moth struggles out of its leathern envelope into the chamber of the cocoon. This being accomplished, the bombyx mori extends its antennæ, together with its head and feet towards the point of the cocoon, which, as already observed, is less secure, and thence emerges into day, leaving the head and entire skin of the late caterpillar, having the resemblance of a heap of foul linen,* in the antichamber from which it retires.† We now have a new creature, the worm, or caterpillar, has become a moth, a butterfly; a reptile that crept on earth is furnished with wings to float in air !‡

* Spectacle de la Nature; Count Dandolo and others.

† It is supposed by some, that the moth, before it escapes from the cocoon uses an acid to dissolve the gum, with which it had coated the interior of the cocoon. The end of the cocoon is observed to be wet for several hours before its egress. It is the middle portion of the cocoon that is unwound in the filature. The outer *floss*, called *floretta*, answers purposes in manufacture when prepared as cotton.

‡ The Hindoos took their notion of the metempsychosis from the transformations of caterpillars. These changes afford a natural argument for the transmigration of souls. "What more probable," says a writer on entomology, "than that its apparent resurrection into life, should be owing to its receiving for tenant the soul of some criminal doomed to animate an insect of similar habits with those which has defiled the human tenement." In the Institute of Menu we find a grade of crimes and punishments; some of which are as follows. "A priest who had drunk wine, shall migrate into a moth or fly, feeding upon or-

The worm commonly employed in the production of silk, is, by Count Dandolo, called, THE SILK WORM OF FOUR MOULTINGS, of which he immediately mentions two *varieties*. 1. Those that form a *straw-coloured cocoon;* and 2. Those that produce the deep yellow cocoon; and gives the preference to the former; stating that "it requires twenty pounds and three-fourths of leaves* to obtain one and a half pounds of cocoons;" which is at the rate of thirteen pounds thirteen ounces and one-third to one pound of cocoons. He mentions, however, three other SPECIES.

1. The SMALL SILK WORM OF THREE MOULTINGS. Of these he observes, "the eggs of this species weigh one-eleventh less than the eggs of the common silk worm, 39,168 of the latter forming an ounce, while 42,260 of the smaller are required to make that weight. The silk worms and cocoons of this species are two-fifths smaller than those of the common sort." He adds that these cocoons are composed of finer and more beautiful silk, and that 400 of them weighed one pound, whilst 240 pounds of the common weighed the same. The count elsewhere acknowledges the general preference to be for the common worm, though he himself is evidently inclined in favour of the small; but the reasons he assigned, countervailed as they are by others, do not appear to be decisive, though the culture of the species may deserve the attention of the experimentalist.

2. The LARGE SILK WORM OF FOUR MOULTINGS. The eggs of this species, the count obtained from Friuli. The eggs were only one-fiftieth more in weight, or 37,440 to the ounce. One hundred of their cocoons weighed one pound; and twelve pounds and a half of leaves yielded one pound of cocoons; but the coarseness of the silk, and the other objections

dure. He who steals the gold of a priest, shall pass a thousand times into bodies of spiders. The man who shall steal honey, shall migrate into a great stinging gnat; but he who shall steal oil, into an oil-drinking ichneumon fly."

* Of the white mulberry.

specified by the author counterbalance any advantages derivable from the preceding considerations.

3. The WORMS THAT PRODUCE WHITE SILK. With respect to this *species* he says, "I have raised a large quantity of these, and found them in all respects equal to the common silk worms of four moultings. If I raised silk worms for the purpose of spinning the silk myself, I would cultivate only the silk worm of three moultings, and those that produce white silk, as preferable to any other; and every year I would choose the whitest and finest cocoons, to prevent the degeneration of the species." This kind was introduced into France about the year 1783, and is there highly esteemed; but it is supposed to be the same that we have, under the name of the "*white worm*," as it produces two crops in a season.*

To the species enumerated by Dandolo, it will be necessary to add:

4. The DARK DRAB COLOURED WORM. This species is very common in the United States. They are commonly called the "*black*" worm. They live longer, and make a greater quantity of silk than the larger white worms.

* It appears from this, and other evidence before us, that we are not yet warranted in pronouncing, as some have done, the TWO CROP SILK WORM as a species distinct from the third species mentioned by Dandolo. If the kind which he designates merely by the term, "*the worms that produce white silk*, and the *two crop silk worm* be identical, the name might be altered to the *two crop white silk worm*. In Tuscany they make two crops of silk annually. The two crops are obtained by a peculiar species of silk worm called the "*two crop worm*," or "*white worm*." This worm, hatched at the usual season, will finish its cocoon, and deposit eggs admitting of being hatched and raising cocoons during the continuance of the same season. This two crop kind moults five times, not three, as has been said. We shall meet with an account of an interesting experiment with this species at Columbus, Ohio, by Mr. Chew, in the Silk Culturist for November, 1837. In Windham county, Connecticut, it is also well known that there is a small pale *white worm*, which eats but twenty days, and produces fine white silk, though in less quantity than either the common *large pale white*, or the *dark coloured worm*; but it has the good quality of retaining its clean white colour, and does not turn yellow by washing, or by exposure to the sun and air. These worms produce also two crops.

5. Silk worms of eight crops.* Of these, there are *two varieties*, as appears by the following statement. Lord Valencia† found at Jungepore, in Bengal, a species of silk worm, supposed to be indigenous, called "*dacey*," producing eight crops of silk the year. He also found another variety, but much inferior, which he terms the "*China*" or "*Madrassa*," which also yields its silk eight times a year.‡

6. The mammoth white silk worm. This is said to be a very superior species, that furnishes cocoons of a large size, and fine texture.

* The distinction between a *one*, *two*, *three*, &c. crop eggs is not by some well understood. It means this, that the eggs of the one crop can be hatched successfully only from the eggs of the *previous year*, kept over winter to the following spring. But the *two* crop eggs may be hatched first from the eggs of the previous year and next from the eggs of the first hatch the same season. The three crop eggs will hatch successively from the same season's eggs in so many repeated times. The eggs of the one crop will not produce worms until the following season.

† Travels to India in 1802, 1806, vol. i. p. 78, Lond., 1809.

‡ This last may be the kind mentioned by Arthur Young, who says he obtained a silk worm from China, which he reared, and in twenty-five days had the cocoons; and by the twenty-ninth or thirtieth day, he had a new progeny feeding in his trays. He remarks, that "they would be a mine of wealth to those who would cultivate them."—Annals of Agriculture, vol. xxiii. p. 235. The variety Madrassa finish the following course in forty days; six days in the egg; twenty-two days, a larva; eleven days a chrysalis; and one day, the imago, or moth.

To the species enumerated in the preceding chapter, we may add others, that are either yet wild, and, therefore, too rarely seen to admit of any minute observance of their habits, or that produce silk from other trees than the mulberry.

1. The Pennsylvanian silk worm. This kind of worm, of which we have an interesting account in the British Annual Register, and also in the Silk Culturist, was found in Pennsylvania by the Rev. S. Pullein. The reverend author says, that he had discovered the *aurelia* of a caterpillar, which, on examination, he found to be not inferior to the silk worm in the quality of its silk. The cocoon is three inches and a quarter in length, and one inch in diameter; the shape not so regular and oval, as the silk worm's cocoon, but nearly resembling a dried bladder. Its colour a reddish brown, and its weight twenty-one grains. It was covered with floss silk. Though perforated by the moth, a part was unwound in hot water, by which the strength and quality of the

staple were ascertained. The fibre being redoubled to make twenty thicknesses, it was found as smooth, elastic, and lustrous as common silk. The common cocoon weighs about three grains; this *seven times as much!* The moth is called isinglass by Marian; it is large, being five inches from tip to tip of the wings. It feeds in the *papilio* state, which the bombyx mori does not, and it makes its cocoon on trees of the hawthorn or crab species.

The same caterpillar, probably, has been described by Mr. Chambers of Uniontown, Pa., as taken from an elder bush, having a cocoon as large as a goose's egg, where others of equal or larger size were also found. The editor of the Silk Culturist, says it is known amongst naturalists as the *attacus cecropia* of Linnæus. It feeds on the currant, elder, barberry, wild-cherry, and other trees. The silk being very strong, has been carded, spun, and woven into fabrics of an enduring quality.

The author of this work, many years ago, found a moth fluttering in an orchard in the state of New Jersey, which exactly answered to the engraving and description of the insect furnished by the Silk Culturist. He has frequently regretted that he had not, at the moment, the opportunity to investigate its nature and habits, but he hopes that means will be adopted by others to domesticate some of these interesting varieties.

The whole of this is fully confirmed in an article from G. B. Smith, Esq., in the Silk Culturist for October, 1837. "I see by the papers that one of our new beginners has discovered, and taken under his care, a new species of silk worm, an American silk worm, whose cocoon is some eight or ten times as heavy as that of the common, and from which he expects profitable results." Mr. Smith, however, does not seem to have been successful with those he tried. He complains that they "would not feed kindly, the moths flew away as soon as they escaped from the cocoons, and the cocoons could not be reeled."

2. The VIRGINIAN SILK WORM. "Mr. Forrest Shepherd, of New Haven, has presented us," says the editor of the Silk Culturist, p. 19, vol. i., "with a specimen of the bombyx Virginiensis, or the native silk worm of Virginia. It is found in great numbers on the plantation of J. B. Gray, Esq., Stafford county, and is capable of enduring the most rigorous winter. The cocoons are found suspended on the *red cedar*, and yield a beautiful white silk of a strong thread.

3. The TUSSEH OR BUGHY SILK WORM is a native of Bengal, exceeding, in size, the common silk worm. The tusseh silk is found in such abundance in Bengal, and the adjoining provinces, as to have afforded, from time immemorial, an ample supply of a most durable *coarse* silk, which is woven into a kind of silk, called tussch-doot-'hies, which is much worn by the Brahmins and other castes of Hindoostan. The caterpillar when full grown, is about four inches in length, and bulky in proportion. Its colour is green, with a lateral stripe of yellow, edged with red. When ready to spin, they envelope themselves in two or three leaves of the jujube tree, the vegetable on which they feed. These leaves form an exterior envelope, which serves as a basin to spin the cocoon in, which is then suspended, by a thick silk cord, from the branch of the tree. It remains nine months in the pupa or chrysalis state, and three months in that of the egg and caterpillar. The moth expands from the extremeties of its wings to five or six inches, the female to eight

inches, and immediately escape. The larvæ feed on the trees, and are watched day and night to guard them against birds. The natives of India pretend that these worms cannot be domesticated. The durability of the silk woven from it is astonishing. Mr. Latreille was convinced that these were the same as the wild worms of China. This kind of silk would, no doubt, be highly useful to the inhabitants of many parts of America and the south of Europe, where a cheap, light, cool, and durable dress, is much wanted.

4. The Arrindy silk worm is the *bombyx cynthia* of naturalists. It is peculiar to the interior of Bengal, and may be reared in a domestic state. The food of this caterpillar consists entirely of the leaves of the common castor oil plant, well known in this country, which the natives of Bengal call *arrindy*. Feeding the caterpillars with these leaves would, therefore, make this plant doubly valuable. This insect is about three inches long when full fed. The colour pale green. The cocoons are remarkably soft, white or yellowish, about two inches long and three in circumference. This insect remains in the pupa state but twenty days. The filaments are so delicate as to render it impracticable to wind off the silk. It is, therefore, spun like cotton; and woven into a coarse kind of white cloth, apparently of a loose texture, but of incredible durability; the life of one person being seldom sufficient to wear out a garment made of it. The coverings of palanquins are made of this silk. It is said, however, that it must always be washed in cold water, since boiling water is destructive of its fabric.

5. The Jarroo silk worm is another kind also found in India; the cocoons of which are spun in the coldest month. The silk is of a darker colour. The males when hatched invariably fly away, but the females remain on the *asseen* tree, (the *terminalia alata glabra* of Roxburgh,) on which the worms are placed to feed. They are not impregnated by the males bred along with them, which fly away; but in ten or twelve hours, another flight of males arrives, the females afterwards deposit their eggs on the branches.

6. The Emperor moth is represented by naturalists as deserving of attention on account of the beauty of its colours, and the excellency of the silk elaborated in the formation of its cocoon. It feeds on fruit trees and on the willow, and spins a cocoon in the form of a Florence flask, of a silk so strong, so thickly woven, and so well gummed, that it has the appearance of damask as to softness, and of leather as to consistence. The *tortrix chlorana*, the *gypsy moth*, the *cream spot*, the *tiger moth*, the *dock weevil*, the *puss moth*, and many others, spin cocoons, the silk of which when carded, for they cannot all be unwound like the common cocoon, make a fine and elastic silk; but are of little use for manufacturing purposes; and, therefore, are merely adverted to here for the sake of bringing as much of the whole subject, on this occasion, before the reader as possible, either for interest or curiosity.

7. The Bombyx chrysorrhœa spins a silken web in company with a society of its fellows of three or four hundred, round the end of two or three adjoining twigs and leaves, allowing space sufficient for the whole of their "*body politic*" to retire within. On the approach of winter, this community, or corporate body, whether it has mayor, recorder, common council or not, shut themselves up in the nest, which by this

time, with the addition of repeated layers of silk, has become so strong and thick as to be impervious to the wind and rain.

8, 9. Tsouen-kien and tyan-kien silk worms of China. These two kinds may be described together. Du Halde* mentions that in the province of Chantong, there is found a species of silk on trees in great quantities, which is spun and made into a stuff called *kient-chou*. This silk is the production of little insects much like caterpillars, which do not spin cocoons, but very long threads, which being driven about by the wind, hang upon trees and bushes, and are gathered for use. The stuff is much coarser than that made of silk spun in houses. The worms are wild, and eat indifferently the leaves of the mulberry and other trees. Of these two varieties, the tsouen-kien is much larger and blacker than the common silk worm; and the tyan-kien much smaller. The silk of the first is of a reddish gray; that of the other is darker. The stuff made of these materials is very close, does not fret, but is very durable, and washes like linen.†

10. The Social silk-nest spinner of South America. Don Luis Nee observed on certain trees growing in Chilpancingo, Tixtala in South America, ovate nests of caterpillars, eight inches long, which the inhabitants manufacture into stockings and handkerchiefs.‡ Great numbers of similar nests, of a dense tissue, resembling Chinese paper, of a brilliant whiteness, and formed of distinct and separate layers, were observed by Humboldt in the province of Mechoacan, on the mountains of Santarosa, at an elevation of 10,500 feet above the ocean level, on various trees. The silk of these nests was an object of commerce, even in the time of Montezuma; and the ancient Mexicans pasted together the interior layers, which may be written on, to form a white glossy pasteboard. Handkerchiefs are still manufactured of it in the region of the late Intendancy of Oaxaca.

11, 12. The Chinese wild silk worm of the fagara and ash tree; and the Chinese wild silk worm of the oak. The memoirs of M. P. d'Incarville make mention of three kinds of these wild silk worms, one feeding on the fagara, or pepper tree, one on the ash, and another on the oak; but the wild worms of the fagara and of the ash are the same. There are two kinds of the ash tree in China, the *tcheou-tchun* and the *kiang-tchun;* of which the former is the same as ours, and on it the wild silk worms feed. After all the Chinese patience that has been expended in taming these little animals, they are pronounced to be incorrigible. From their cocoon, in which they spend the winter, they emerge in spring metamorphosed into a moth, when they provide for their successors and disappear. Were they brought into a warm place, their *exodus* would doubtless take place earlier, as that of the common worm, whose precocious egress is most probably effected by artificial interference. Hence, the suggestion arises, that were our cocoons kept in a low temperature from the moment of their first formation, and brought out on the ensuing spring to produce eggs, instead of

* History of China, vol. III. p. 359.

† See Histoire des Sciences, les Arts des Chinois par Mailla, tom. 2. p. 575, and Robertson's Disquisition concerning ancient India, vol. 13, p. 434, note 33. Madame Lottin's Treatise on Silk worms, Paris, 1757.

‡ Annals of Botany, 2d, p. 104.

hatching them in the usual way, that they would, in this case, give fresh eggs as wanted. And whether nature did not so intend them to produce is an inquiry worthy of the attention of the culturist.

These wild worms moult four times, each of which is four days distant from the other. To preserve them from hornets, wasps, and birds, a net is spread over the tree; and from insects, a trench of water is formed round it. The cocoons of these worms are said to be as large as eggs, and are carded, not wound. The larva of full growth is nearly twice the size as that of the common worm.

Some kinds of wild silk worms that feed on other trees than the mulberry are found even on our own continent. In the first volume of the American Philosophical Society of Philadelphia, is a paper by the late Moses Bartram, in which are recorded some experiments in propagating caterpillars from cocoons found on the black haw, alder, and wild crab tree. Though, from these and similar productions of nature most attempts as yet have failed to procure a continuous thread; yet the thread obtained by Rev. Mr. Pullein from the cocoon of the isinglass moth bore, when of the thickness of twenty single fibres, a weight of fifteen and a half ounces, whilst the thread of the same size of the common silk worm always broke with fifteen.

Silk, a substance so important to man, has naturally directed the attention of the entomologist, and his inquiries relative to all the different animated existences producing this material, have passed the limits of the caterpillar, or lepidoptera order, to insects of a very different character.

Of SPIDERS there are many species; most of them extend their labours no further than merely to make a web to ensnare and detain their food. But others are known to go beyond this, and spin a bag in the form of a cocoon, for the protection of their eggs, nearly similar to that of the silk worm. The discovery that the fibres of these cells possessed considerable tenacity induced M. Bonn to a filature of their cocoons. It appears from authentic documents, that M. Bonn was successful, and that he not only found out the method of reeling, but also succeeded in manufacturing several articles from their silk, particularly gloves. M. Bonn has noticed only two kinds of silk spiders; from one of which he procured the finest quality of raw silk; which he affirms is equally beautiful, strong and glossy, with that formed from the bombyx. The spider spins from fine papillæ placed in the hinder part of its body, which serve the office of so many wire-drawing implements to form and mould a viscous liquor, which, like that of the silk worm, dries and forms silk on exposure to the atmosphere, forming filaments capable, as matter of fact has proved, of being made conducive to human convenience and covering. Reaumer states that he has seen, whilst this insect has been producing its silk, as many as seventy or eighty fibres through a microscope; and perceived that there were infinitely more than he could reckon; so that he thought himself within bounds, by saying, that from the tip of each of the five papillæ, there were furnished 1,000 separate fibres, or 5,000 in all to form one filament of a spider's web! This may seem questionable to some not accustomed to the microscopic manipulations of nature; but whoever consults M. Leuwenhock will find that 400 fibres of a young spider are not larger than one made by another

full grown; that a hundred fibres of the adult insect are only equal to the diameter of a hair; or that if the fibres and hair be both round, 1,000 fibres will scarcely be equal to the hair of a man's beard. Calculations mathematically exact cannot be expected concerning such minute objects; they are, however, sufficiently so to intimate the astonishing minuteness of a fibre, and the reason of the strength of the filament composed of them.

"It may interest the curious reader to know by what process Mr. Bonn proceeded to attain such surprising results. He commenced by collecting from various places the bags or cocoons of the short legged spider, to the amount of twelve or thirteen ounces. They were beaten with a stick until entirely free from dust, and next washed in warm water, which was continually changed, until it no longer became clouded or discoloured. After this they were steeped in a large quantity of water wherein soap, saltpetre, and gum-arabic had been dissolved. The whole was then set to boil over a gentle fire, during three hours; after which the bags were rinced in clean warm water to discharge the soap. They were then dried; in a few days carded, the cards being finer than those used in carding silk. Thus a silk of a peculiar ash colour, the threads being stronger and finer than those of common silk, was obtained, and capable of standing any trial of the loom.*

M. Reaumer questions the last statement, and thinks it will not bear a weight as great as that sustained by the fibres of the silk worm. But this difference of opinion needs produce no quarrel, since it has yet to be discovered in what way silk bags from spiders can be produced in quantity sufficient for the use of even one individual. But M. Bonn states that a female spider produces from 600 to 700 eggs, while of the 100 to which he erroneously limits the silk worm, not more than one half he raised to produce cocoons. He affirms that spiders are more hardy, will breed more rapidly and with less loss. Of 700 to 800 young spiders kept by him, hardly one died. He says the spider is not venomous. When bitten by them, he found that their own silk was efficacious in healing the wound. M. Reaumer, appointed by the Royal Academy of Paris to investigate this subject, declared that spiders were unsocial beings, their natural fierceness and venom rendering them unfit to live together; the larger spiders always destroyed the smaller when put together, rendering mulberry leaves or any other food unnecessary, and by which their commonwealth became speedily depopulated. "It appears," says M. Reaumer, "that the work of one silk worm was equal to that of ninety-two spiders; and that one pound of spider silk would require the production of 27,648 insects."

We will now turn to the PINNA, a little edible muscle of the *vermes testacea* order—a limax, with a bivalve fragile shell, and furnished with a beard, the valve hinges without a tooth. It does not fasten itself to the rock like other muscles, but sticks its sharp end in the sand, the other end being at liberty to open and shut in the water. In common with the muscle it has the power of spinning a viscid matter from its body like the spider or caterpillar. Its length is often two feet, and the

* See Lardner, part II. p. 142, 143, 144, &c.

threads it produces are scarcely inferior in fineness and beauty to the single filament of the silk worm. Like the threads of the spider, its fibres singly do not possess much strength, but the almost infinite number which each fish puts forth to secure itself in a fixed position, amidst the commotion of the waves, make up for their fragility. The pinna differs from the muscle in the number and superior firmness of its filaments. These shell-fish have been distinguished, the one as the silk worm, the other as the caterpillar of the sea.

M. Reaumer says that he placed the pinna in a glass vessel filled with sea water to observe its mode of spinning. They opened the shell, put forth the tongue, extended and protracted it several times in every direction, and having fixed on a place by feeling, whereon to deposit its threads, it placed its tongue for some time on a chosen spot, and drawing it in with great quickness, it formed a thread, one end of which was fastened to the place selected. This operation it repeated until its threads were sufficient for its purpose. The threads when detached at one end, were soon replaced by new ones. The pinna is found in the Indian Ocean, but the largest and most remarkable are in the Mediterranean Sea, on the southern coast of France or of Italy.

The threads of the pinna have been known to the ancients, and were used by them in the manufacture of certain fabrics. The silk produced by the pinna, as in the case of the spider, is in quantity limited, but the fineness of pinna silk, greatly exceeds that of the spider, if it excel not that of even the silk worm itself. Of this silk, caps, gloves, stockings, waistcoats, and other garments, whether in simple or mixed fabrics, have been made to some extent in Sicily, and Toronto in Italy. A pair of stockings made of pinna silk may be contained in a snuff-box of ordinary size. They are warmer than those of silk, and more lustrous, though thinner. The pinnæ are raked up from the rocks and sand, with an iron fork made of a peculiar shape; and they are sometimes taken in considerable quantities.

CHAPTER II.

COCOONERY : EGGS : HATCHING : STATISTICS.

Every wise man in bringing a progeny depending on his providence into being, should not only provide *food*, but also *shelter* for their comfort and protection. Relative to the former, the ample details already furnished when treating on the mulberry tree, require nothing further to be added; we will now,

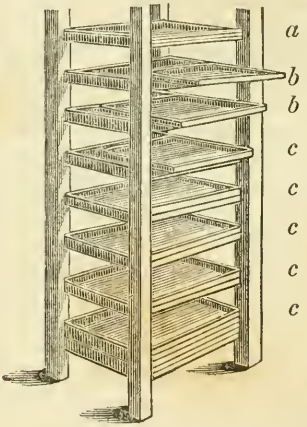
therefore, describe the accommodations requisite, during the process of feeding the silk worm, for its growth, health, and maturity.

No small part of the minute directions given by European writers, arrangements considered by them as necessary for the successful rearing of the silk worm, arises from the state of their climate. Although much attention should be every where paid to this department of the business, yet the superior excellence and peculiar adaptation of the climate of the United States to this culture renders many considerations, thought in Europe and elsewhere to be indispensable, here altogether unnecessary. In fact, what is difficult, complex, and demanding extraordinary care in Europe, can be performed amongst us with comparative facility and ease. This, however, has induced some authors, either almost entirely to omit this part of the subject, or to run into wild extravagance, with respect to what requires close attention. It has been said, that the silk worm can be reared with ease under an open shed, in any room, or almost under any imaginable circumstance in this felicitous climate. Without calling in question the practicability, and the occasional success of this extreme of venturesome negligence, we affirm that unqualified reliance must not be placed on such statements. Man is rather inclined to degenerate than to improve, and if he be led to suppose that silk worms will *almost* take care for themselves; there then wants but one step to arrive at the persuasion that they can do it *altogether*. Care should, therefore, be taken to furnish something like system, from which, without the warrant of experience, no wide departure should be allowed. Notwithstanding the operations are extremely simple; yet to secure complete success they demand both attention and care.

A COCOONERY may be constructed of any indefinite length, breadth and height. But to be more precise; we will here suppose one of medium dimensions, calculated to admit of feeding conveniently half a million

of worms. Let the building be fifty-four feet long, twenty-two feet wide, ten feet high, and of one story. In this apartment there may be *three* rows of frames, each of eight tiers, fourteen inches above another; the lowest one foot above the floor, and the upper a suitable distance below the pitch of the roof. These frames should be constructed horizontally between upright posts, one on each side, as in the following figure.

Fig. 3

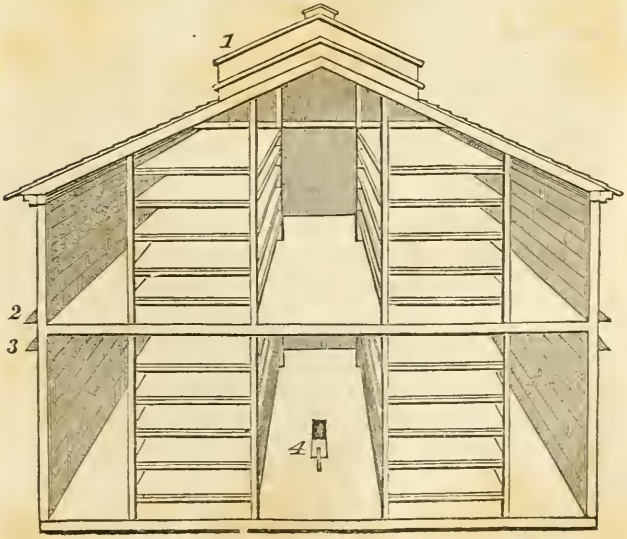


The posts should stand five feet apart, so that the shelves for feeding the worms may be six feet by three feet at the bottom, but gradually diminishing in width by one or two inches to the upper platform or frame. The next upper one being lessened equally on each side. On each shelf, *a b b c c c*, is placed a frame of net work or millinet resting on a piece of wood fastened to the sides of the shelf about one inch above the level of the shelf. The shelf itself is stationary, and rests on slips or slats of wood nailed to the two posts on each side that compose the shelf. The frame or hurdle resting on the ledging of the shelf, and about an inch above it, is movable. On this, and on the shelves the worms are fed, and the intention is to

permit the litter produced in feeding the worms to fall through, so that by alternating their position, they may be frequently cleaned without inconvenience. The above engraving represents one shelf as in a whole range. In the ranges constructed in the building above described, there may be *eight* successive shelves following each other thus, : : : : the dots representing the posts and space between the shelves.

The frames should never touch the walls on any side. A free passage should be left all round for the convenience of the persons feeding. Silk worms are the prey of innumerable insects, as spiders, ants, beetles, and others; against which they should be carefully guarded, by sweeping all cobwebs off, keeping the walls and floors clean, and examining the premises with repeated and close attention. The diagram or cut which follows exhibits an end view of a cocoonery of two stories. The post should be three inches square.

Fig. 4.



The roof is surmounted by a ventilator (1), another may be observed on the centre of the lower floor (4), with a sliding board to open and shut; also two on each side (2, 3,), one above and one below the floor of the second story. The view is from one end to the other. The gangway or passages between the tiers of shelves being before the eye lengthwise.

Count Dandolo estimates his shelves or wicker trays to be two and a half feet wide. The width may depend on the room. If made for the purpose, let it be with reference to rule. If apartments in private houses are used, the walls being plastered will not be so apt to harbour vermin. The ventilators should always be increased according to the dimensions of the building, but where the quantity fed in one place is small, there will not be much hazard in the feeding. In Broosa, and other places in Turkey, the worms are almost always fed in the private apartments of dwelling-houses; and the litter is never removed, but remains a pile on the floor, the worms extricating themselves to keep above the dirt, as well as they can, till they mount to spin.

The walls of the building should have windows at regular distances; we do not mean regularly glazed windows, though some light is necessary. But instead of glass, stationary blinds moving on an axis, and rising or falling by a slip of wood attached to each in a perpendicular position. The blinds being horizontal. By pressing this slip up or down the blinds will open to admit light and air, or close to exclude both, so that the windows act as ventilators, or for air, as well as light.

On the under surface of the shelves and hurdles, on which the worms are, and facing downward, are constructed the *corners*, as we may call them, on which the caterpillars may mount and spin. Many contrivances may be made for this purpose, and almost any one will answer. Some give them a branch of an oak, some a bunch of straw, others a head of broom corn, or other means according to the convenience of

the silk grower. We have seen a more convenient plan than any of these, and offering, we should suppose, as favourable a retreat for the caterpillar to spin, as for the culturist to collect the result of its labour. This is by covering the under part of the shelves, or that which canopies the hurdle beneath, with laths of two to two and a half inches wide, nailed on edgewise, three inches apart, over the bottom of the shelves, the under one excepted. This presents a serrated surface, into which the worms ascend by the aid of what are called *ladders*. These are formed of cotton cord, of sufficient size, fastened to the sides of the hurdles below ; and the lower and inner edge of the serrated canopy above, running the cord from one end of the shelf or hurdle to the other, in the same manner as a bed bottom is corded, except that the latter is constructed vertically. The worm will not, therefore, have to ascend this ladder perpendicularly, but at an angle of about forty-five degrees. When they ascend, they seek out a corner, alongside probably of another, in one of these indentations, and there spins its cocoon. They can easily be abstracted when the spinning is complete. The caterpillar always ascends before it spins. Some will crawl to the roof, if permitted, but most stop at the apartments prepared for them.

When the shelves ascend above the breast, a safe and suitable ladder should be provided, so that the hurdles may be taken out by the feeder in a horizontal position, when he proceeds to clean the shelves.

Having now explained the form of the cocoonery, or *Atelier*,* as it is called in France, it will be sufficient for us merely to allude to a vast volume of apparatus recommended by Count Dandolo to the *European* culturist, as almost necessary, at least as beneficial, in the management of a large establishment of silk worms. The count himself occupies not less than thirty pages in the description of his thermometrographs, thermometers, hygrometers, barometers, ban-

* Atelier de vers à soie, a workshop, or spinning place for silk worms.

boxes, stoves, flash-fire grates, ventilators, and a variety of subordinate laboratories. It is universally agreed among all writers acquainted with this climate that these are here generally redundant and unnecessary. In short, experience and matter of fact, even in the most unfavourable sections of the Union, have proved this to be generally the case. A good thermometer, indeed, would, in certain cases, be useful, and never superfluous, especially where the superintendent is desirous to make notes and record experiments relative to the hatching and operations of the progeny under his care. Though in actual practice, more bushels of cocoons may be raised without than with one, yet a good thermometer cannot be otherwise than occasionally advantageous in a cocoonery.*

* "Since the publication of this work," says the London translator of Count Dandolo, "there have been erected large laboratories in Lombardy, which are called, *Dandolieres*, an honorary testimony to the philanthropical Parmentier of Italy." The name, therefore, is already established and acknowledged, and cannot be altered for the better. It is the name of a species of cocoonery, or of that kind recommended by the count, more particularly useful for humid climates than for this, and therefore, furnished with all the apparatus and correctives which he describes.

In the outward and general construction, it differs not, except as to its dimensions, being calculated for twenty ounces of eggs, in anything essential, from the one already described. It is immediately connected, however, with a subsidiary laboratory or room, into which the count removed the worms after the fourth moulting. The building was thirty feet wide, seventy-seven long, and twelve high, and when reckoned to the top of the roof twenty-one feet high. There are thirteen unglazed windows, with Venetian shutters outside, and paper frames inside; under each window near the floor, are ventilators, or square apertures of about thirteen inches such as to be closed by a neatly fitted sliding pannel, so as to permit the air to circulate and blow over the whole floor. When the air is not wanted, the paper frames may be closed. There are eight ventilators, in two lines, in the floor and in the ceiling, placed perpendicularly, opposite to one another, in the centre of the passages between the hurdles or trays. They have sliding pannels made of thick glass, to close them, and to admit light from above. As the air of the floor ventilators ascends, that of the ceiling ventilators descends, it must pass through the trays. There are also, other six ventilators, made in the floor to communicate with the rooms beneath. Three of the thirteen windows are at the end of the house, and at the opposite end are three doors, constructed so as to admit more or less air as required. These

The EGGS OF THE SILK WORM are so small that more than sixty are requisite to weigh one grain. In appearance they exactly resemble a poppy-seed; in colour, they are, when first laid, of a yellowish hue, but change in three or four days to a bluish, or, as seen through a microscope to a purplish cast, with a greyish sprinkle over them. The egg has a small hollow, or flattened indentation on its upper surface; the under is glued to the cloth or paper, and is flat. Those that continue of the colour they had at first, are not fecundated, and, of course, worthless.

THE PRESERVATION AND TREATMENT OF EGGS. In some places eggs are sold in bottles, having been not without detriment previously scraped off the cloth. Eggs of this description no one should purchase, especially since this mode has facilitated the mixing of the seed of the poppy with them, a deception, whilst they remain on cloth or paper, not easily practised. It is possible not only for a theoretical but also for a practical man to commit mistakes, some of which may be even egregious, if not absurd. If the latter should be

doors open into another hall thirty-six feet long, and thirty wide, which forms a continuation of the large laboratory, and contains trays sufficiently raised to facilitate the care of the worms. In this hall there are six windows, and six ventilators under them, and also four ventilators in the ceiling. There are six fire places in the great laboratory, one in each angle, and one on each side of the centre, and a large stove in the middle. Argand lamps, that give no smoke, are used to give light at night. Between the hall and the great laboratory, there is a small room, having two large doors, the one communicating with the laboratory, the other with the hall. In the centre of the floor, there is a large square opening, which communicates with the lower part of the building. This is closed with a wooden door. This aperture is used for throwing down the litter, and for admitting fresh leaves, drawn up by a hand pulley."—Now if to this we add the thermometrographs, the thermometers, hygrometers, barometers, and all the other etceteras, of the count's thirty pages, we shall have that species of a cocoonery called a *Dandoliere*. And if ever Sir Richard Philip's grand epoch shall arrive, when by the entire revolution of the precession of the equinoxes, some twenty-five thousand years hence, the seas of the Antarctic hemisphere, we are told, shall be transferred to those of the Arctic, and vice versâ; and it should rain here, as it does at Manchester, where they say it rains always, we will repair to Lombardy to take a more exact pattern of a *Dandoliere*.

popular, and determined to oppose some favourite fancy or conjectural benefit to nature, reason and comparative investigation, some scores of mere theorists are ready to follow in his wake, and to echo his prescript as something infallible and oracular. Hence it has been recommended by a number of copyists, to scrape the eggs off the paper or cloth, to wash them with water or wine, or to employ other preposterous and unnatural manœuvres. Nothing can be more evident than that this is an officious interference with the regular manipulation of nature; any *artificial* misdirection of this kind, is, to say the least, supererogatory and detrimental.

We, therefore, object to washing, or to any similar interference with the process of nature, as laid down by Count Dandolo and M. d'Homergue. The unfecundated eggs will not hinder the impregnated from hatching, nor injure their vitality, as has been represented, by their vicinity. The writer last mentioned says, "no degree of cold can hurt them, provided they do not freeze." In this country it has been abundantly tested that no degree of cold, even down to zero, can injure them, provided that they are not suddenly raised or depressed from one extreme of cold or heat to another. It is a sudden transition of temperature by which they are injured.* Eggs permitted to remain under the influence of a high temperature will hatch, and young larvæ, whether the mulberry leaf be ready or not, will present themselves, to pass through all the several stages of the parent.

* The caterpillar in her natural state lays her eggs in situations exposed to the changes of the seasons. They will, therefore, remain uninjured by freezing and cold. In disposing her eggs, the silk worm covers them with a gummy substance, which resists the ordinary variations of the seasons. The eggs of the bombyx mori have been deposited on a board in an exposed situation all winter, through the storms and tempests of the season, and though frequently covered with snow and ice, whilst the thermometer has been even below zero, yet they have preserved their vitality, and hatched at the natural thermal change, precisely when the same cause has simultaneously developed the vegetable alimen intended for the sustenance of their future existence.

Eggs, when laid, must be kept dry and cold, and preserved in a vessel or by other means from the attacks of insects or vermin; if in summer or autumn, in a temperature not exceeding fifty-five degrees. When spring arrives, they should be placed in an ice-house, or in some such place where they can be kept in a temperature not greater than from forty to forty-five degrees, for though at some degrees above this, they may not hatch, yet they will be liable to addle, as they would be if kept in a cellar, where the unavoidable dampness of such places would promote this accident, and consequently disappoint the hopes of the silk-grower. A cellar, therefore, is not a good place for them. In the winter, a dry cool garret is better; where they must be protected from vermin and insects, by many of which they are devoured. To keep them from the atmospheric air is not according to nature, which is the best guide in most cases; on the contrary, wherever kept, they should be frequently aired, as the exclusion of air is one undoubted means of destroying their vitality. They may, by thus artificially preserving them, at a low dry temperature, be kept to any part of the season which is desirable. The cocoon also, as soon as formed, may be preserved in a low temperature, and in the spring brought into a higher one. In this way the chrysalis remains in a torpid state until the warmth revives it, when it changes its coat, emerges from its confinement, lays its eggs, and dies. Such eggs, too, will be fresh and better for a new hatchment than those deposited during the previous fall. Under all circumstances, it must ever be remembered, that it is not proper to allow a hatch, until the food is ready for the young larvæ in sufficient abundance.

Hatching. No hatching should at any time be attempted, until the mulberry leaves are springing sufficiently to promise an abundant supply, during their first and every successive age, as the larvæ increase in size to use them. It is always safer to be a few days too late than too early. The multicaulis

leaf should be well developed, as when too young these leaves, as well as others, are less healthy than when mature. In removing the eggs from the ice-house for the purpose of hatching them, care should be taken not to introduce them too suddenly to a change of temperature. They should be cautiously and gradually brought from a cold to a warm atmosphere, until the temperature be from seventy-five degrees to eighty degrees. Otherwise through the injury from sudden transition, sustained by organization so delicate they either would not hatch at all, or hatch and die soon after.

The method in hatching eggs pursued at Broosa, says Mr. Rhind, is, "the temperature of the chamber, near the place where the eggs are put, should be 63½ degrees. This is effected by increasing the fire, should the temperature be less, or by opening the ventilator or door, should it be more. This should be carefully maintained for two consecutive days. On the *third* day, the temperature is raised to 66°; on the *fourth*, to 68°; on the *fifth*, to 70°; on the *sixth*, to 72°; on the *seventh*, to 75°; on the *eighth*, to 77°; on the *ninth*, to 79°; and on the *tenth*, *eleventh* and *twelfth*, to 81°." This is quoted, to show that it is not mere precision that is here essential to success, but rather a gradual elevation of temperature to that maximum of heat which a transition from the egg to the larva requires.*

* Mr. Smith says, "At the period for hatching, which in Maryland is generally about the 1st of May, the eggs may be brought out, and their papers spread on a common table, called the hatching table. The proper period is always best ascertained by the state of the mulberry leaves. I consider the best and most safe time to be that when the leaves are about the size of a half-dollar. The hatching table may be kept in the common laboratory. In large establishments, a small, close room, with a stove, will be very useful in hatching the eggs, as the temperature may be regulated at pleasure. But in this case, a thermometer is almost indispensable, as the necessary equability and gradual increase of heat could not be secured without one."

M. de la Brousse, who, we must remember, wrote for the climate of France, says, "The eggs, on white paper, are to be placed on a clean table, separating each ounce of eggs, and leaving a space of six or eight

When the eggs are thus carefully exposed to heat, in the manner we have described, they will show signs of vitality from the seventh to the tenth day, and by a good eye, or a glass, may be seen within the pellicle of their covering. Count Dandolo says, "The following are the signs of the speedy vivification of the silk worm. The ash-gray colour of the eggs grows bluish, then purplish, it then again grows gray, with a cast of yellow, and finally of a dingy white. These shades of colour will vary, and they depend also on the means used in washing the eggs." This washing, however, is what we advise to be left out, as ridiculously superfluous. The tender leaves of the mulberry should now be in readiness, and scattered on the trays, shelves, or table where they are placed, and the attendant should be up by the dawn of day to watch them. The young larvæ, resembling a small black worm, generally appear from sunrise to ten o'clock in the morning. Those that do not leave their shell at the latter hour, usually remain until the next morning. It is important to keep the worms of each day's hatch by themselves, which may easily be done by the leaves placed near them for their early sustenance, to which those that have left the shell will immediately and instinctively attach themselves, and are, therefore, thus easily separated and removed wherever the person tending them chooses. The hatch of any one day, particularly if sufficiently large, should, all through the season of feeding, be kept by itself; but

inches all around each parcel, for the reception of small leaves of the mulberry. This table, of a size proportioned to the quantity of eggs that we intend to spread on it, ought to be placed in a room seven or eight feet square, and seven or eight in height, closely wainscoted or plastered, with a fire-place, or, still better, a stove, for the maintenance of a proper temperature. A fire must be made in this little room, early in the morning, at noon, and at ten in the evening, for three days before the eggs are placed in it, in order that the air and the walls should be made dry and warm." M. de la Brousse, however, would begin with the temperature of 77°, increase it on each day 2°, until it attain a maximum of 92°.

never should the hatches of more than two consecutive days be placed together, as they cannot thus pass, during the time of feeding, through the several moultings together; and the consequence will be, that on the same shelf worms will be found eating voraciously, whilst others are sick or in the act of moulting, or worms in different states, requiring different treatment, which will be inconvenient, if not detrimental. In short, in all cases, worms of the same age, even to a day, and in the same state, should be distinctly classed, and always placed by themselves.*

The silk worm at no time evinces much inclination for motion; and if properly fed and provided, will not travel beyond the distance of two or three feet throughout the whole of its pilgrimage from the egg to the cocoon. But when the young worm first appears, unless food be near, it displays considerable

* Count Dandolo, who seems to have obtained credit for his skill in the rearing of silk worms, as well on account of his factitious details and minuteness, as of his having in some measure led the way in this art, but not for either simplicity or brevity, qualities of which he knew little, gives us an elaborate description of the method of hatching the silk worm. He informs us that the egg-cloths should be steeped in water, stretched on a board, scraped off with a dull knife, then washed in a basin with clean water; the water skimmed to take off dirt and bad eggs; put into another basin, and steeped in wine; then again washed, rubbed, drained, and dried on linen cloths!

On this, Mr. Roberts remarks as follows, "Where, we would ask, did the worms, in their native state, procure the *scrapers* and persons to use them! Where did they derive the water to perform their ablutions in? Where, let us ask, has science derived the knowledge, that the gummy substance, which gives to the eggs their cohesive property, should be removed?"

It seems to us, that when the larva becomes vivified, and is about to emerge from confinement, it needs no aid but what nature had provided, that is, the fixed foundation on which the shell and egg were deposited, against which, as against a fulcrum, the insect is enabled to act mechanically, and facilitate its escape from the embryo state. If it emerge at all without this fulcrum, it performs more than Archimedes could, when he said, "Δος που στω, και την γην κινησω"—"Give me only a place whereon I can stand, and I will shake the earth." But this very "που στω," "*place whereon I can stand*," Count Dandolo and his copyists take away, by their scrapers, ablutions, and wine-washings, and leave the little folks to act mechanically on moonshine, if they can.

activity. Its strong desire to eat, which it immediately manifests, impels it to wander anywhere for food. But if this desire be satisfied by an adequate and timely provision, they seldom show an inclination to leave the shelves on which their wants are supplied. Should this, at any time, take place, which will only be occasioned by hunger, the mere smell of a leaf is sufficient to bring them back to their domicile. This disinclination to locomotion is one of the greatest advantages of the *domestic* over the *wild* silk worm; otherwise, the trouble consequent on their attendance would be immense. Providence, without our contrivance, has ordained it otherwise, so that our attendance on their little but important wants, is an interesting specimen of the coalition of profit and amusement.

We have not stated any special day or week of the calendar for the hatching to commence. As already observed, this should be regulated by the time when the food is in sufficient abundance on the branches of the mulberry tree. Before we commence a history of the life of the insect from the time of its egress from the egg, it may be proper to premise, that each of the moultings through which it is destined to pass may be considered as a disease. The period of moulting is about twenty-four hours, during which it lies in a torpid state, and refuses to eat. They are then greatly injured by disturbance, and, therefore, as already remarked, all in the same stage of forwardness should be classed distinctly, or be in a place or places separate from those of any other stage, that the feeding or attendance necessary to one, may not disturb another class in a different condition.

Diseases.—The silk worms are, too, through improper or negligent treatment, liable to several diseases, sufficiently distinct, by criteria peculiar to each, from one another. With these diseases it may be proper to become acquainted, before we enter on the important operation of feeding, that the silk grower may, as he advances, understand, at every step, the

prognostics by which one disease is distinguished from another, and the remedies necessary to arrest its progress. Some of these diseases *may* be engendered by the climate, but more either by that peculiar treatment of the eggs, which fortunately is better known elsewhere than here, or by some negligence in the feeding, or mismanagement during the respective stages; but the whole of this, whether experienced in this or in other countries, it is incumbent on us to bring here, *in proprio loco*, under one view.

The Congressional Report on the Silk Worm enumerates eight causes of disease in silk worms, viz:

"1. Errors in the hatching of eggs, and in the treatment of very young worms.

"2. Unwholesome air of the district in which they were bred.

"3. Impurity in the air in which they are kept; arising from imperfect ventilation, from the exhalations of the litter and fœces of the worms, which have been permitted to accumulate.

"4. Too close crowding, owing to which cause their spiracles (spiracula) or breathing orifices were stopped, and the expiration and inspiration of air prevented.*

"5. The quality and quantity of food.

"6. Improper change of food.

"7. Peculiar constitution of the air in certain seasons, against which no precaution can avail.†

"8. Frequent changes of temperature in the room in which they are kept."

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1. *Diseases from defect in the eggs.* It is said, that when the department destined for the coming

* Had not mechanical impediment been contemplated here, we might have suspected the philosophical accuracy of this statement; and supposed that the writer intended to say, that by crowding, the vital principle, or oxygen, in any proximate volume of air was impaired; which we yet suspect is more or less, on such occasions, combined with any impediment that is mechanical.

† Indeed! What, not even a *Dandoliere*, nor the Count's fumigating bottle, nor the chloride of lime! Credat Judæus, non ego.

forth and laying of the eggs of the moth, is *too cold*, below fifty-nine degrees, (say sixty degrees) the impregnating liquor will not be perfected; and consequently, it does not give them their ashy, yellowish colour, which in the course of fifteen or twenty days, indicates the perfect impregnation. Those imperfectly fecundated bear in them the elements of disease. Let those who select eggs notice this; an important hint, whilst the eggs are so dear. A room *too hot*, seventy-seven to eighty-one degrees, is also injurious. If the male delays coition, he loses much of the impregnating liquid; if he couples too soon, before the female has discharged a fluid with which she is loaded, her eggs become imperfect, and their larvæ will be liable to disease. Or when the place where the eggs are kept, is *too damp*, or they are *too thickly* heaped together, in either case they are injured. In the former, the evaporation or drying requisite to their maturity is prevented; in the latter, they heat, and the embryo is impaired.

No disease, however, from any of these causes will occur, when 1. the temperature of the room, appropriated to the moths and their evolutions, is kept between sixty-eight and seventy-five degrees; 2. when the apartment is dry; 3. when the cloths or paper on which the eggs are deposited are not too much folded, and are properly hung on frames.—*Diseases, also arising from the mismanagement of good eggs* remain to be mentioned under this head. When the temperature, whilst the embryo is approximating to the state of the larva, is too suddenly elevated, the organization suffers partial decomposition, indicated by the reddish colour of the shell, which is a prognostic of disease in the insect. Injurious consequences also follow a sudden depression of temperature; in short, sudden transitions are to be avoided throughout the whole existence of the animal.

2. *Diseases from the bad air of the district in which silk worms are reared.* Low marshy places, productive of noxious vapour; all situations where

the air is liable to become stagnant; and certain effluvia, especially that from tobacco, or tobacco smoke from segars are injurious, the latter being speedy death to the worm. On the contrary, high and elevated places, where wholesome air exists, are salutary to the worm, and favourable to the quality of the silk, the product of its labours.

3. *Diseases from impurity in the air of the cocoonery.* When the air of the cocoonery is not frequently renewed, particularly in the two last ages, a large volume of evaporation and effluvia from the insects and their litter, stagnates, the transpiration is checked, the fœces and decomposition of the litter emit noxious exhalations, and the worms become relaxed, and disease follows in a few hours. That cocooneries and all apartments in which numerous silk worms are kept, should be well ventilated, is, therefore, *indispensable;* and for this very purpose, in all regular establishments ventilators are constructed.

When the air is liable to acquire a morbid tendency, besides the ordinary ventilation, its noxious qualities may, by fumigation and other means, be *chemically* neutralized. This, however, must be done with care and judgment. Nothing should be consumed in the midst of the cocoonery, but under some chimney, or in some fireplace constructed for that and similar purposes, to which the bad air may be drawn in a current and consumed. Mr. Nysten, page 105, has given his opinion as to the total inefficacy, as a corrective, of all *mere* perfumes, though he has not assigned the reason; which is, that from them there is only *mechanical* diffusion in the air, but no *chemical* action, and consequently nothing is neutralized. For establishments containing numerous insects, those from five ounces of eggs or more, the occasional and prudent use of the chemical fumigatory, is to be recommended. For this purpose put six ounces of common salt, well mixed, with three ounces of the black oxide of manganese into a bottle,

to which add two ounces of water; which keep well corked remote from any stove or fire. In another bottle provided with a *glass ground stopper*, (since acids carbonize and destroy all corks, by which the acid itself becomes injured,) put a pound and a half of sulphuric acid; and be provided with any small china or delf cup or glass,* by which the quantity of two-thirds of a spoonful, by any mark within or otherwise, may be ascertained when fumigation is required; in the glass, or earthen cup, measure two-thirds of a spoonful of the sulphuric acid,† which pour into the first bottle, and immediately a whitish vapour will ascend. Let this, always held at an elevation above the head or nostrils‡ be carried backwards and for-

* Instead of this in the books we find an *iron* spoon recommended. This, however, is somewhat singular, since it is well known that all metals, particularly iron, decompose the water of the mineral acids, and consequently hydrogen gas is evolved. But no acid except the fluoric, has any action on china, glazed earthenware or glass. In practice, a small cream jug, or vessel having a spout, will be found to be the most convenient. Chlorine gas is wanted from this fumigatory, which has a powerful *disinfecting* power; but any hydrogen gas would be improper. "Accounts have been received from Spain," says the well-known chemist, Samuel Parkes, "that in the midst of the dreadful contagion which reigned in that country, the inhabitants of those houses where fumigations of *chlorine gas* were used, had no attacks of sickness, and enjoyed the best health."

† Before the nomenclature of Fourcroix and Lavoisier, or in the language of mere alchymy, sulphuric acid was called the *oil of vitriol*. It is so, in some measure yet, but very improperly, since not a particle of vitriol exists in its composition. It will be here necessary to caution all unaccustomed to its use. If a drop, or the smallest quantity fall on the clothes, the colour is changed, and the fabric in that place destroyed; if it fall on the hand or skin, the epidermis is destroyed, but if a particle fly into the eye, or reach that tender region by a finger not previously well washed even after handling the bottle, painful or destructive consequences to the sight will follow. In this latter case apply immediately and liberally soap-suds, or alkali, and wash off with water. On the clothes apply *directly* liquid ammonia, and both colour and texture are instantly restored. For this purpose these materials should always be at hand.

‡ In the books it is recommended to carry the bottle above the head; but the proper expression would be above the eyes, mouth or nostrils, since chlorine gas notwithstanding all its disinfecting power, is far from being fit for being breathed, especially in its undiluted state, and in that state would be injurious to the organs of vision. When in a highly

wards several times through the cocoonery, and when the vapour ceases return the cork, and replace the bottle. If the state of the room require it, let this process be repeated, *pro re natâ*, during the two last stages particularly of the worm. If the cocoonery is large, either repeat oftener, increase the mixture, or which is better, have two bottles containing the mixture of the first. In the last days of the worm, the bottle may, particularly if on some elevated and central place, be left open an hour or two each day, or moved when elevated into various parts of the cocoonery. This remedy should be repeated as often as foulness is indicated. When a fireplace is in the laboratory, a few shavings may be occasionally burned in the last stages, which will draw in a fresh current of air; but even this, if cleanliness be strictly attended to, is scarcely requisite. In short, we may remember, as the Chinese have done for ages, that cleanliness is a "*sine quâ non*" in raising silk.

4. *Diseases from want of room.* When silk worms are on the shelves, crowded too much, they become unhealthy. In removing them, the hand need not be applied to the insect. It is only necessary to apply another hurdle with fresh leaves in it to the side of the shelf or hurdle, where the crowded worms are; which, by the smell of the leaves, they will perceive and crawl over to them. When a sufficient number has passed, the hurdle can be applied to another shelf, and so on, till the crowded shelves have

diluted state, i. e. as when smelt at a short distance, it occasions coughing; but if a small quantity of the gas, whilst yet undiluted with atmospheric air, enter the mouth or nostrils, painful and extreme irritability, if not confinement, is the consequence. The death of the ingenious chemist Pelletier was occasioned by inhaling by accident a large portion of this gas. His lungs were instantly irretrievably injured, and consumption and death followed. On the contrary, by being first held high above the mouth or nostrils, the gas rises by its specific levity, is diluted by a large volume of atmospheric air, in which whilst it disinfects or neutralizes noxious mixtures, becomes itself neutralized, and consequently innoxious before it reaches the respiratory organs of man or insect. It is proper here to be remarked, that the use of the chloride of lime instead is free from these inconveniences.

been sufficiently thinned. Silk worms breathe through little orifices, or spiracula, situated on each side, near their legs. Consequently being crowded, to them is a greater mechanical obstruction than it would be to animals otherwise circumstanced.

5. *Diseases from the quality or quantity of food.* On this point little need be said. The worms should be fed with great attention to their peculiar wants. The leaves should be given dry. Wet leaves produce a diarrhœa, according to some; but others, on the contrary, state that they have washed dry leaves, squeezed out between two moist cloths the excess of water, and given them with a quantity of humidity, as nearly the same they had when fresh, to the worms. It is proper to observe that fresh leaves seem to be such as nature intended for the worms, which at all times have a degree of natural moisture, though externally they may be either wet or dry. But we approve of dry leaves, though fresh as possible, being given. It is better that they should be even a little wilted, than externally moist or wet. The experience of American culturists vary on this subject. It is more than probable that a degree of that care which may be really requisite in a climate not natural to the insect, is redundant in this country, which at all latitudes is isothermal with China, and consequently, the only one, perhaps, in the world, equally favourable to its exigencies. The leaves should be given after having lain a day in a cool place, thinly spread to prevent heating. In the anticipation of rainy weather, a supply for three days may be procured. Leaves taken from trees growing in moist soil and shady places are not proper. Over and under feeding may equally produce disease. The leaves after being pulled may be exposed to the sun a few minutes, and then set in a dry place to cool.

6. *Diseases from improper change of food.* Changing the leaves of the red for the white or other species of mulberry tree is sometimes detrimental,

or whenever this order is reversed. The leaves of different species or varieties of mulberries should not be given at the same time; much less any leaf of inferior quality be administered within the last ages of feeding; since this would occasion derangement in the animal, imperfect spinning and inferior silk: exceptions to this consequence are rare.

7. *Diseases from a peculiar constitution of the air.* The eudiometer does not seem to be an instrument at all times adequate to detect the variable circumstances that may disturb, the heterogeneous substances held in solution that may enter, or the different states, greater or less rarefaction, that may affect the general constitution of atmospheric air, and consequently vegetable and animal life. Count Dandolo complained of the year 1814. The farmers in England will ever remember the year 1816. The farmer, the horticulturist, the orchardist, all complain of unfavourable seasons; and the medical man, or his patients, of endemical and epidemical times. And whether we have the influenza or the cholera, we lay the blame to the air, and demand of the meteorologist its component parts. His answer is ready, and he replies in three terms, and we are no wiser. But all this time a myriad evanescent things, hidden from eye, from ear, from sense, may be in operation. We know not what magnetic currents, what mundane plates of electricity, positive and negative, may be in play, high in aerial climes, but affecting below all animal and vegetable life. All that we can do, in cases that transcend all ordinary experience, is to use the precautions already prescribed, or such of them as the variable circumstances of the season may require.*

* The year 1816, was, in England, one of unprecedented rain and humidity. The rain began to fall, soon after the earth got warmed by the sun, and the evaporation was abundant. After this, the alternation between excessive evaporation from below, and torrents of continuous rain from above was incessant during the summer and a large part of the autumn. The farmer sought hedges or walls on which to dry his hay, for the ground was unfit. The reapers were in some places up to

8. *Diseases from sudden changes of temperature.* We must ever remember that the insects, which we suppose to be now under our care, are tender, and of a delicate constitution; and therefore we should be provided with every suitable means to correct any sudden, extraordinary or unexpected variation of temperature. And this care should be continued not only during their feeding, but also through their spinning season; especially since the liquid gum in the secretor from which they spin, if the temperature be too low, congeals, and arrests, unless due warmth be immediately restored, the spinning process, and the silk in this case is lost. The directions already given, will on this point, and in this climate be sufficient.

On the air, the quality of the food, and the degree of care and attendance which the caterpillar receives, through its several ages, and even during the fabrication of its cocoon, depend the time it occupies in its respective changes, and the excellency of its silk. It has not been generally customary as yet to *feed it through the night*, but experience has proved that where night feeding has been attended to, the worms are stronger, the cocoons heavier, the silk superior, and the time shorter between the egg and the consummation of its toil.

Particular Diseases. The names ordinarily given to the diseases of silk worms, are not those employed to signify the same in Lombardy, but those given in L'Abbe Rozier's Cour d'Agriculture, which is an excellent compendium of all written on silk worms by French authors.

the ankles in mud to cut the wheat, and the sheaves, for want of sun to ripen, had to remain in the fields until the snow of an early winter began to cover them! Who would not say, that had silk worms been rearing in such a climate and in such a season, that a Dandoliere, with all its apparatus of stoves and chimney-places, for sudden flash fires, and other corrections of excessive humidity, would have been desirable? In the same year (1816) there was almost no summer in the United States. Frost occurred in this state every month in the year save one, and the changeableness of the season was disastrous to vegetation.

1. The Passis.—This is a vague expression, and means little that is special, since it is derived from *passus*, that merely signifies *suffering*. Custom however has arbitrarily applied it to signify in the insect a kind of *marasmus*, *atrophy*, or simple waste of muscular substance. *This disease is known*, 1st, from the yellow tinge of the worms; 2d, from its lengthened spare shape and wrinkled skin; 3d, from its sharp and stretched feet; 4th, it eats little, languishes, and is evidently in a state of atrophy.

The *cause* is said to be an excess of heat maintained during the dormant states, or convalescences immediately after the respective moultings, or to the length of time the worm is suffered to remain under the pressure of litter. The *remedies* are instant removal from the healthy worms to an apartment which is well ventilated, and where they can be distinctly attended to. They should have a due supply of tender leaves, a uniform temperature, but a little higher than that required by the worm in a state of health.

2. The Grasserie, derived from the French *gras*, *grasse*, fat, full, &c. This disease generally appears towards the second moulting, rarely later, and is scarcely known in the fourth age. *The symptoms* are, 1st, they eat, but do not digest their food; hence, 2dly, they swell and become bloated; 3dly, their bodies become opaque and of a greenish colour; 4th, the circumference around their breathing apertures, become of a citron colour, or of a dirty white; 5th, their skins tear from the least touch, and sometimes spontaneously burst from over distension; 6th, they are covered with a viscous, oily humour; 7th, they appear disposed to obtain relief from distension to stretch their feet; 8th, the acrid humour proceeding from it. The last stage of this disease is death to any worm with which it comes into contact.

The *causes* are said by Mr. Nysten to be the too glutinous nature of the food given to the worm in its second and third ages; by Mr. Roberts, the too substantial food for the young worms, occasioning indi-

gestion ; by La Brousse, too abundant nourishment, badly regulated, or to the neglect of drying the leaves when wet by rain or dew, and to the lack of fresh air during the last changes of the worms. The *remedies* are, if not too late, 1. instant removal to a distinct room or place ; 2. lessen the quantity of nourishment ; 3. give the thin leaves of the wild, or of some inferior mulberry ; and 4. ventilation and moderate temperature.

3. Luisette, from *luire* to *shine*. There are but few worms attacked by this disease, which seldom appears till after the fourth moulting, or fifth age. The symptoms are 1. the *luisettes*, or *shiners*, feed and grow like others, except in thickness ; 2. their colour, first of a clear red, soon changes to a dirty white ; 3. if attentively observed, it will be seen to drop a viscous humour from its silk tubes ; 4. their body becomes transparent, which has occasioned the name of the *luisette* or *glow worm*.

Causes. On being opened, their stomach has been found empty, except of a glairy transparent fluid, which has led to the inference that this malady is occasioned by negligence in feeding, or by a partial supply of food ; a theory since proved by M. Nysten,* who produced the disease by starving some worms for twenty-four hours.

Remedy. The translator of Count Dandolo, and M. la Brousse prescribe a short remedy, viz. "throw them away." Others have either more patience or more mercy, and advise 1. instant removal ; 2. a supply of food, *gradually*, not suddenly increased, until perfect restoration.

4. The Yellows is the name of a disease that appears about the fifth age, when the worms are filled with a silky fluid, and are about to spin.

Symptoms. 1. The body swells, and the enlargement of the rings gives to the feet an appearance of being drawn up from the tumescence of the adjacent

* Recherches sur le Maladies des vers a soie, par P. H. Nysten, Paris, 1808. Des Vers a Soie, par M. Reynard, Paris, 1824.

parts; 2. the worm acquires a yellow colour; 3. they cease to eat, and run about, leaving stains of a yellow fluid; 4. the yellowness first appears around the spiracula, and is thence diffused over the external surface; 5. the insects soon become soft, and burst; 6. the morbid humour issuing from them is fatal to the worm that touches it.

Causes. The Abbe Sauvage ascribes this affection to sudden exposures to great heat. It is also elsewhere imputed by him to indigestible food, and exposure to the influence of rainy or moist weather. It is said also to be an anasarca, or dropsy of the skin, arising from a defect in the absorbent vessels of its system.

Remedy. 1. Instant removal, as on all similar occasions; 2. ventilation or a change of air, assisted by fires if necessary; 3. in two cases, oak leaves were given, with success.

5. The Muscardine, or *numbness.* This disease appears in the fifth age.

Symptoms. 1. Black spots appear in different parts; 2. they next become yellow, and finally red, or of the colour of cinnamon, which is diffused over the whole body; 3. The worm becomes hard and dry, and covered ultimately with a white mould.

Cause. 1. A continuance of a hot, dry, and close air.

Remedies. 1. Removal; 2. purify the air by repeated fumigations; 3. and promote an active circulation in its current, by ventilation.

6. The Tripes, or *mort blanc.* We are informed that M. Rigaud de Lisle, inhabitant of Crest, first discovered this to be a distinct disorder. *Symptoms,* the worms become flaccid and soft. When dead, they preserve a fresh and healthy appearance, and on being touched, they feel, it is said, like *tripe:* hence the name.

Cause. The disease appearing chiefly during most or rainy weather; and M. Nysten's experimental proof that it may be produced from the vapid

exhalations from the litter of an uncleansed cocoonery, sufficiently indicate that an excess of moisture, held in mechanical diffusion in the atmosphere, is incompatible with the health of the insect.

Remedies. 1. Instant removal as before ; 2. dry the air of the infirmary apartment by sudden flash fires, under chimneys provided for the purpose, and keep up the warmth and dryness of the room by continuous fires in stoves at a proper temperature.*

Though it is necessary in a work of this kind to mention the diseases that occur through either negligence or mismanagement, yet we may rest assured that if only the cautions and treatment prescribed in this work, suited to the several stages of our insect colony, be observed, the worms of our establishment, however numerous, will be preserved in perfect health. *Of worms, through negligence, the French, M. Beauvais informs us, formerly lost fifty per cent. ; whilst the Chinese, bringing their experience of* 4000 *years to bear on their charge, scarcely lose one per cent. ! This difference carried out into the million, is* 490,000 *worms ;* or a difference in silk of 163 pounds, worth $815: sufficient to show the value of the timely care and vigilant attention of our *five weeks'* services, for which the little generous animals will pay us so liberally.†

* The discovery of and remedy for this disease has been aseribed to Mr. G. B. Smith, of Baltimore. How long a time has elapsed since the discovery, we know not; but we find the remedy recommended in Lardner and others, and it was probably known from ten to fifteen years ago at least. The *chloride* of *lime,* as a fumigator and purifier, has been known since its first discovery, and the application of such a chemical preparation, publicly known to possess such properties, is a discovery which would have suggested itself to every one requiring its aid. The disease itself may have been first pointed out by the very respectable gentleman above named. But the remedy claimed for Mr. Smith has been known to others, at a prior date, and has been mentioned by Lardner at least, without knowing that such suggestions had been followed elsewhere. Vide Lardner, 133.

† Besides the diseases commonly mentioned by writers in this country, the following, which are evidently distinct morbid affections, are also described by Italian and French authors.

7. The Scarlet. This disease is so called from the more or less

Enemies to Silk Worms. The enemies of silk worms are *sparrows*, *swallows*, *robbins*, the *titmouse*, and *poultry*. Care must therefore be taken to exclude them, by keeping, when necessary, the win-

dark red colour which the skin of the silk worm assumes when issuing from the egg. The worms attacked by this disorder seem cramped, stupified, and suffocated. Their rings dry up, and they look exactly like mummies. The red colour then becomes ashy and white. This disorder does not always kill the worm in the first moulting, nor yet in the second; and sometimes, they do not die until after the fourth moulting. When, if they live so long, it becomes more difficult to distinguish them, as their colour becomes less dark, and cannot be so easily separated from the healthy, since they might be mistaken by the most practised eye. They will even weave cocoons, which are good for nothing, called *cafignons*, from being soft and ill-woven.

8. The Dragées. This is not properly a disease of the silk worm, since the cocoon is already formed, when it is called a dragée. A dragée cocoon does not contain a chrysalis, but a worm short and white, like a sugar plum: hence it has been also called the *white comfit*. If the worm, after having made the cocoon, has not been able to change into a chrysalis, it is a proof that, in that state, it was sick. But it is not likely that a disease that never occurs except in a chamber hermetically sealed from all observation, can be accurately defined by the *faculty* that attend on silk worms or on any other kind of patients. In Europe, whole broods have been found, of which nearly all the cocoons are affected with the dragée. This, however, except as to the eggs, is not a loss, for the cocoons are unimpaired in quality. As an article of sale, they are undervalued, but the proprietor that reels himself, finds them as profitable, both as to quantity and quality, as any other cocoons. A dragée cocoon is known by shaking it, when the sound resulting from a dried substance may be perceived.

9. The Calcinaccio. "*Calcination*," says M. Dandolo, "is not a disease observed in any other species of worm, not even in the caterpillars that live in the open air; which evidently proves that it proceeds from bad management. This disease is the result of certain chemical combinations, which may decompose the component substance of the silk worm at any period of its existence. The causes which produce it are such, that sometimes it will declare itself rapidly, or sometimes it will remain dormant until the moment of rising on the hedge, and even when it has formed the cocoon. It becomes general in a laboratory, or is partial, according as the chemical element that produces it is spread or confined to peculiar parts; but it is never contagious. A worm having died by calcination, put in contact with a healthy worm, will in no degree affect it." M. Decapitani having publicly asserted that calcination was the result of catarrhal affection, the count, in 1818, entered into a series of ten experiments, which successfully proved the error of the hypothesis of M Decapitani.

10. The Gattine. By Gattina (*Ital.*) or Gattine (*French*) is gene-

dows closed. Besides these, such vermin as mice, rats, weasels, lizards, ants, and spiders, are to be catalogued as enemies. The last are said to make the most active war against silk worms. Spider webs ought, therefore, to be carefully cleared away, and all possible precautions should be taken against the other enemies that beset them. To prevent the attack of ants, or other creeping insects, the posts supporting the fixed shelves, or any part of the frames, ought not to touch either the ceiling or the walls; and the legs of the posts ought to be smeared with molasses, or placed in basins of water, where ants are known to harbour: both these methods would be a more secure preventive. Vermin of other kinds, as mice, rats, etc., must be trapped and killed in the usual way.

Statistics relative to silk worm eggs and space *requisite for feeding.* Whether we are about to commence the silk culture on the small or large scale, it is of importance to know how many silk worms, at least on the average, we may expect from an ounce of eggs. But here as usual, instead of having any thing like certainty and precision, in what may be considered to be an element in statistical calculation on this subject, we have by the irreconcilable statements of all that have written on this topic, for at least the last twenty years, all that sort of obscurity which may be conceived to arise from the twofold source of error, *discrepancy* and *ambiguity.* We have before

rally understood a worm that cannot accomplish the functions of nature to which it is destined according to the degree of change that it has experienced. This disease is indicated by restlessness, seeking seclusion, loss of appetite; though some eat well, live through several ages, and then, from instinctive desire of separation, die off the tray, or on the edge of it, but not on the litter, unless attacked by the disease suddenly, and have no strength to retreat.

The *causes* assigned by Count Dandolo and Morin, are, 1. Injury as to the eggs, from error in the preservation, hatching, removal, or carriage; 2. Subsequent negligence as to temperature, air, or food. "There cannot exist disease," says the count, "when the egg is well impregnated, well preserved, and the silk worm well attended to." No *remedies*, except the preventive, have as yet been prescribed for this malady.

us statements relative to the number of eggs in an ounce, that vacillate at all points between the two extremes of 42,000 and 20,000 per ounce; and others condescend not even to say whether, by the number they quote, they mean simply the eggs, or the number of worms we may expect from an ounce, or the number at the hatch that will weigh an ounce.

All, however, in this, whether Italian, French, German, English or American writers, seem to follow Count Dandolo. Notwithstanding the count's very venial but yet evident eccentricities, wherein he has carried the favourite pursuit of his life beyond the "*est modus in rebus*," yet is he to this day, in several points relative to silk culture, the *facile princeps*. Had any one or two of the numerous copyists that have followed in his wake, exemplified the same indefatigable patience in minute investigation, all incertitude on this, and on certain other points, would have been at an end; since, thus, in the mouth of two or three witnesses, *not copyists*, every thing had been established.

Of those that have stated 42,000, 40,000, 35,000, 30,000, 29,000, 22,640, and 20,000, to the ounce, we could quote the principal and most popular authors that have written on this subject within the last twenty years, in this country, or in Europe. The 42,000 is a number that is some second edition of Dandolo's statement of 42,260 eggs to the ounce of his little worms, of three moultings, and therefore has nothing to do with the calculation. The 40,000 is the convenient echo in round numbers of the count's discovery that 39,168 eggs of the common silk worm weigh one ounce. This and all the rest, however modified, by taking off one-third for, as we are told, presumed loss, or for other reasons, are evidently derived, seldom with acknowledgment, but without any thing independent, any thing new on the subject.

The whole, therefore, whether Italian, French, German, English or American writers, on this point, being plainly convicted, on the *primâ facie* evidence of the

trial, of a second-hand character, we shall repair at once to our Pythagoras, not with servile obsequiousness "*jurare in verba magistri*," nor to echo an "*ipse dixit*," but to institute an inquiry, relative to a point in silk culture, which may be considered as an element, and, therefore, important in statistical calculation.

The count says,* "to make one ounce of picked eggs, there should be, for an average weight, 39,168 eggs. *I observed with some surprise, that there was little difference in the weight of eggs belonging to above twenty persons.*" Dandolo, therefore, had ascertained this fact by at least twenty distinct trials! Where have we another example of patient investigation equal to this? Not one! So easy is it to copy, or to quote the words of another as *our* doctrine; so difficult to be original. The count adds,

"I have had the *patience* to count many hundred thousand eggs, in hopes that it might be useful," (true patriotism exercised in that whence least expected; "*in tenui labor*,") "in the art of rearing silk worms. The best eggs when weighed afforded no more than sixty-eight eggs per grain.† And the inferior quality of eggs did not afford more than seventy eggs per grain." He afterwards adds, "one ounce is composed of 576 grains."

But what is to be inferred from this? The count lived at *Varese*‡ near Milan in Lombardy, a region where both the number of grains in a pound, and the grain itself as weighed by any standard unit is constantly shifting every fifty or sixty miles. In Florence

* P. 73 and 74.

† This would be equivalent to seventy-three to the English grain.

‡ Count Dandolo made those experiments on his estate, Varese, near Milan, where he opened a real school for the silk culture, and where he gathered around him some young men, to whom he read lectures on this art. The count died of apoplexy on the 12th of December, 1819. His laboratory still exists at Varese, and had been imitated in several places. It is indeed a perfect model. The Italians call these laboratories, *Dandolieres*, from gratitude to the person through whose instruction the crops of silk have *increased tenfold* in Italy, and who has secured to his country an abundant source of wealth." Count de Hazzi.

the pound is equal to 5286* grains English; the pound at Genoa to 4426; at Naples to 4952; at Rome to 5257; at Turin to 4940; and at Venice they use two pounds, the greater and the less; one of 6826, and the other of 4215 English grains. But we are nowhere accurately informed what the natives of these places respectively term a grain, nor how many, in each case, they reckon either to the pound or ounce. The number of grains, 576, in Dandolo's ounce being one-tenth of 5760, the number of *English* grains in a pound troy, added to a *vague* report from the neighbourhood of Naples, either that an *Italian* pound consists of ten *Italian* ounces, or is equal to ten *English* ounces, has led some to conjecture that Dandolo's ounce was equal to one-tenth of a pound troy. But since the 576 grains quoted by him are no aliquot part, neither tenth nor twelfth at least of any one, on the list now before us of the sixty-five European pounds, whose quantities are expressed in English grains, it is sufficiently evident, that we are to understand 576 *Italian* not *English* grains. The count, however, has elsewhere informed us that the *Milan* pound consists of twelve ounces, and consequently of 6912 *Milanese* grains, and that twenty-eight ounces of Milan are equivalent to about twenty-five French ounces; without however stating of what French pound.† Dr. Lardner, however, without quoting authority, undertakes to decide that 533 Milanese grains are equal to one ounce avoirdupois. That is, 39,168 silk worm eggs weigh 576 Milanese grains: therefore, at the same rate, 36,244 are in weight equal

* Though no notice is taken in avoirdupois tables of any denomination lower than a drachm; yet an avoirdupois pound is equal to 7000 grains; and no grain is used in English weights but that in troy and apothecaries weights, *which are the same.* Of these the pound troy contains 5760; the ounce troy 480, and the ounce avoirdupois 437½.

† The following list will be sufficient to show the necessity of being special in quoting foreign weights or measures, when that of a single nation can shift into shapes as many as those of the Protean god. The pound of Avignon is equal to 6217 English grains: of Bordeaux to 7460 of Lisle to 6544; of Marseilles to 6041; of Montpelier to 6217;

to our avoirdupois ounce of 437½ grains. We are not warranted, therefore, making some deduction for loss, to quote more than 35,000 eggs to the English avoirdupois ounce.

Mr. Roberts, to make allowance for a possible loss of one-third, or thirty-three per cent., gives 20,000 to the ounce. Here then is meant, eggs that succeed in the hatch, which evidently agrees, accounting for the deduction, with the statement we have given. But we see no need for loss to any such extent, since the Chinese can boast that their loss exceeds not one per cent.*

We cannot here omit to mention another interesting discovery, relative to the eggs of the silk worm, that did not escape the vigilance of Dandolo. He found that 576 grains, or one Milanese ounce of eggs, lost on being brought into the store room, in order to hatching, or at the temperature of 64°, forty-seven grains by evaporation; and that the shells or husks, after hatching weighed 116 grains. Hence, 163 grains deducted from 576, leave the weight of the 39,168 worms immediately after hatchment to be 413 grains. "At this rate," says he, "54,526 young worms are required to form the weight of one ounce,"

the *silk* pound of Lyons to 6946, the common to 6431; of Nancy to 7038; of Rouen to 7772; of Toulouse to 6323; and of Paris to 7561. Neither the hecatogramme, nor the chiliogramme of the French National Institute is, in quantity, any thing near to one pound. We are informed, it is true, that the Milan pound is equal to 5400 *French* grains, which are equal to 4430 English grains, or 369 *English* grains to the Milanese ounce; but this would give the doubtful result of 46,439 silk worm eggs to the avoirdupois ounce.

* We take this opportunity to advise every future and ingenious culturist to provide himself with a set of apothecaries weights and scales. He will find it useful for many domestic purposes. It will contain the following weights: of grains, from the half grain to six grains; the half scruple equal to ten grains; the scruple twenty grains; two scruples or forty grains; the drachm sixty grains, eight of which are equal to one ounce troy or apothecaries, or 480 grains; and the two drachm weight. Let him by repeated trials find the number of eggs that weigh five grains, and multiply the number by eighty-seven and a half; he will then have the number of eggs weighing an avoirdupois ounce of 437½ grains.

i. e. Milanese ounce of 576 grains, equal to 533 English grains. Hence $\frac{54526 \times 533}{576} = 50{,}548$ newly hatched worms; which are equal to ounce avoirdupois.

The Count, besides informing us that it requires immediately after hatching 54,626 young worms to weigh an ounce, also states, that after the *first moulting*, "3840 are sufficient to make up that weight; and that the worm, therefore, has increased in six days, *fourteen times* its own weight:" that after the *second moulting* 610 will form this weight; or that it has increased its average weight *sixfold;* that at the end of the *third moulting*, 144 worms weigh an ounce, implying an increase more than *fourfold;* that at the end of the *fourth moulting*, only thirty-five are requisite to the ounce, proving again a *fourfold* increase; and that at the close of the *fifth moulting* even six silk worms weigh the same as 54,526 immediately after hatching, nearly an increase of *six times* their size in the preceding age; or an entire increase in all of 9000 times from the first commencement of the larva state. From these premises, it must necessarily follow that one English ounce of worms immediately after hatching, will, on the supposition that none are lost, weigh 9000 ounces at mounting to spin the cocoon; or 5 cwts. 0 qrs. 2 lbs. 8 oz. for every ounce of worms!!*

The whole of the history of this little insect, is to the naturalist too interesting, and to the culturist too important, to allow any thing of a statistical character to pass unobserved. We have already remarked, that according to the calculation of Count Dandolo, these almost microscopic animalculæ require, immediately after the hatch, 54,626 to weigh one ounce; but at the end of the first age 3840 worms; at the end of the second 610; at the end of the third 144; at the end of the fourth 35; and at the end of the fifth only six

* See Lardner, p. 105, and Dandolo, passim.

are required to weigh one ounce. These numbers, however, are respectively adapted to the Milan ounce of 576 Milanese grains; to 533 of which, one avoirdupois ounce of 437·5 English grains, is equal; to which if the above numbers and ratios are reduced, they will stand as follows:

Immediately after hatching, it will require 50,548 silk worm larvæ to weigh one English avoirdupois ounce; at the end of the *first age* 3553, when the ratio of increase in weight is more than fourteen times the first state of the larva; at the end of the second age, 564, the ratio of increase exceeding six times the weight at the end of the first age; at the end of the third age, 133, the ratio on the maximum weight of the preceding age being more than quadruple; at the end of the fourth age, thirty-two, the ratio being more than four; at the end of the fifth age, 5,552, or little more than five and a half worms, if well fed, will weigh one English avoirdupois ounce, the ratio of increase exceeding that of the quintuple on the former state of existence. But the whole ratio of increase from the hatchment to the full size of the last age, will be 9088; or, in round numbers, a *single ounce* of the insects, each of which at the hatch weighed less than nine one-thousandth parts of a grain, *in less than five weeks*, will weigh more than 9000 ounces!!! That is, a single worm will at the following specified stages of its existence weigh respectively as stated below.

	English Grains.
At the hatch one worm will weigh.....	·00865
At the end of the 1st age it will weigh	·12313
2d.....	·77570
3d.....	3·28947
4th.....	13·67187
5th.....	78·86023

or 9000 times its first weight!

But how does a unit of any dimensions become in five weeks 9000 such units? Here we cannot but remember that the leaves of the mulberry, by *insect-chemistry*, are marvellously converted, 1st, into a worm: 2dly, into a silken cocoon: then 3dly, by art

into raw silk, and lastly into fabrics finer than which nothing can adorn the persons of emperors or queens, nor embellish their palaces and thrones. During the five weeks, one worm has consumed, on the average, about 340 grains, or twelve drachms eleven grains avoirdupois of leaves; more than three-fourths of which have evidently passed off by the pores and other emunctories; and there remain of the 340 grains, seventy-eight and forty-three fiftieths* grains, transformed into the substance of the worm.

The whole of this statement deduced from Count Dandolo, is, however, somewhat at variance with what he has himself taught us in the latter part of his volume.† He there observes that 360 worms produce, on the average, one pound and a half of cocoons, and that the silk worms *proceeding* from five ounces of eggs will yield 600 pounds of cocoons. Hence it is evident,‡ that his calculations all through, are for 144,000 *surviving* worms from five ounces of eggs; and not for 200,000, as some, calculating on 40,000 worms from each of the five ounces, have supposed. But this 144,000 from five Milanese ounces are only equal to 133,250§ worms from five English avoirdupois ounces; or to 26,650 *surviving* worms from each avoirdupois ounce. If Mr. Roberts calculates only for 100,000 *surviving* worms from five ounces of eggs, or 20,000 from one, the difference of 33,250 is between him and the count, in favour, however, of the latter; or rather in favour of the count's *argus-eyed* vigilance and care, and of the superiority of the *dandoliere* and its almost *self-regulating correctives*, over that of the comparatively *chance-helmed* cocooncry. That difference, how-

* 27·34375 grains are equal to an avoirdupois drachm; but sixty grains to a drachm apothecaries, eight of which make an ounce of apothecaries, or troy weight.

† Page 195, et seq.

‡ $\frac{360 \times 600}{1{\cdot}5} = 144{,}000.$

§ $\frac{144000 \times 533}{576} = 133{,}250.$

ever, is one of thirty-three per cent., in favour of the Italian patriot in silk culture. It follows that when our zeal, our enthusiasm, are equal to those of the indefatigable Dandolo, we shall have 26,650 surviving insect artisans from every ounce of eggs; or 26,650 that live to the cocoon out of every 36,244 originally in the shell.

But the 133,250 survivors from five ounces of eggs, would at the moment of becoming larvæ, weigh only 2 ounces, 10·177 drachms avoirdupois.* To trace now with accuracy the actual increase in weight from the incipient larva to the completion of the fifth age, and then the decrease in insect substance, and vegetable consumption, to the cocoon, we refer once more to our most assiduous experimentalist. At page 195 he observes, "the result of my experiments proves that 360 silk worms,which produce about one pound and a half of cocoons, weigh, when at their highest growth and size, three pounds, three ounces and a half. The silk worms, after this, are ready, in the course of two or three days, to begin their cocoons, and then weigh only about two pounds† seven ounces. When the silk worms begin to rise, they void a quantity of nearly pure water, part of which is sometimes discharged through the silk-drawing tubes, and by transpiration. They also evacuate a small quantity of solid substance, and then form the cocoon in three or four days: these cocoons altogether weigh about one pound and a half. Let us now imagine a laboratory calculated to contain the silk worms proceeding

* $\frac{1 \times 133250}{50548}$ =2 ounces 10·177 drachms.

† Some discrepancy either in the original translation or type is evident throughout the whole of this statement; for here two pounds, seven ounces, are made equal to the forty-two ounces mentioned a few lines afterwards. Again, notwithstanding that in the appendix we are told that twelve ounces make the Milanese pound, it is evident here, that all the count's reckoning is by some pound of sixteen ounces; since $\frac{(1285 \times 16+3) \times 42}{1050 \times 16}$ =3 lbs. 3½ oz. which agrees with his statement; whilst twelve ounces to the pound do not.

from five ounces of eggs, and sufficient to produce about six quintals* of cocoons; the following will offer the result. If 360 silk worms weigh three pounds, three ounces and a half, when in their utmost growth and perfection, it must clearly appear that the whole of the silk worms of the laboratory, which produce 600 pounds of cocoons, will weigh 1,285 pounds, three ounces, when they reach their utmost growth. And if the 360 silk worms, previous to beginning their cocoons, only weigh forty-two ounces, it must appear equally clear, that the whole of the silk worms of the laboratory will be about ten quintals, fifty pounds. And therefore, in three days, the silk worms must have lost 237½* pounds weight of substance, either solid or liquid, from exhalation or steam. And if after two or three days, the silk worms that are reduced to ten quintals and fifty pounds weight, are changed into 600 pounds of cocoons; it is evident that in three or four days, they must have lost 450 pounds weight of substance either in liquid, vapour, or gas. In the space of six or seven days, therefore, the bodies of the insects requisite to produce only 600 pounds of cocoons, must have lost 700 pounds in weight and substance. This astonishing quantity excreted from the bodies of the worms in so short a time, is of greater weight than the total weight of the cocoons and aurelias, which only weigh 600 pounds."

By an attentive investigation of the preceding statements of Count Dandolo, it will be sufficiently evident that he is calculating by the poids de marc of Charlemagne, equal to 7561 English troy grains. Consequently, the 144,000 surviving worms of the laboratory, to which his calculations refer, and which he says at their maximum size weigh 1285 lbs. 3 oz. weigh 9,717,301 English grains; or 67·48 grains each. And the 50,548 larvæ that immediately at the

* A quintal is equal to 100 pounds.

† (1285 lbs. 3 oz.—1050) = 235 lbs. 3 oz. and not 237½ lbs.

hatch weighed one ounce, will at their maximum size weigh 4 cwt. 1 qr. 11 lbs. 4 oz. 10 dr. 17½ grains; that is, one ounce of worms at the hatch, if well fed, will in five weeks weigh 487 lbs. 4 oz. 10 drachms, 17½ grains!! We prefer this result to the former; the premises of which are comparatively vague and approximate.

But if the calculation be referred to the count's 144,000 surviving silk worms that were originally five Milanese ounces in the shell, and 1285 pounds, three ounces of the same weight at their maximum size, and finally only 600 Milan pounds in the cocoon, and we find that they have consumed in their growth, according to the same authority, 7520 Milan pounds, of the white mulberry leaves, it is evident that nearly *five-sixths* of the entire quantity of food consumed by these insects have passed off by evaporation and otherwise before they attain their maximum size, and more than *eleven-twelfths* before the completion of the cocoon. Here are, therefore, eleven-twelfths, at least, or 6886 lbs. of the 7520 lbs. that must pass off by evaporation, ventilation, or in litter, before we have the consummation of the laboratory in cocoons. "It is scarcely credible," says Dandolo, "that the bodies of the silk worm should yield so much noxious matter in a few days, were it not demonstrated by positive facts. It is needless to remark how much this large body of exhalation, were it stagnant in the laboratory, might in the latter days generate disorders, and cause great mortality at the very moment when the abundant crop of cocoons was confidently expected. We must, therefore, deeply feel the necessity of attentively following the prescribed directions for avoiding this evil."

This is more minutely and clearly stated by the count in a calculation that he afterwards enters into for a single ounce. "The result of the most exact calculation is, that the quantity of leaves drawn from the trees, employed for each ounce of eggs, amounts

to *one thousand, six hundred and nine pounds, eight ounces,* divided in the following manner.

	Sorted leaves. lbs.	Refuse picked from the leaves. lbs. oz.	Loss by evaporation &c. during the whole period of picking. lbs. oz.
1st age	6	1 8	
2d	18	3 0	105 0
3d	60	9 0	
4th	180	27 0	142 8
5th	1098	102 0	1362 0
	1362	142 8	1609 8

Relative to the refuse to be picked from the leaves, he observes: "Great care must be taken in picking and sorting the leaves for the feeding of the worms of the first ages, such as picking off all twigs, stalks, spots, &c.; and to clear them as much as possible from all useless parts. This operation is most essential in the two first ages, when the leaves are to be chopped very small. In the third age, the sorting and picking is not of so much consequence, and still less so in the subsequent ages. The sorting and picking is of importance, inasmuch as it enables you to put fifteen or twenty per cent. *less* substance on the shelves, than would otherwise be done, which the worms do not eat. This substance increases the litter and the moisture, without necessity or motive. In the two last ages, leaves mixed with a quantity of boughs and stalks may be put on the hurdles, although it is known that the worms do not eat them; because at that period it would be too troublesome to sort so large a quantity perfectly, nor is there the same motive to do so. These substances being by this time grown large, hard and woody, are less liable to fermentation, although they may accumulate as litter.

It has been observed that the leaves distributed on the hurdles *per ounce of eggs* were 1362 lbs. During the life of the silk worms there has been carried away from the hurdles,

	In gross litter. lbs.	oz.	dr.	Of which in fœcal substance existed lbs.	oz.	dr.
In the 1st age	1	4	0	0	1	4
— 2d	4	8	0	1	3	0
— 3d	19	8	0	3	9	4
— 4th	60	0	0	18	9	4
— 5th	660	0	0	132	0	0
	745	8	0	155	7	4

Deducting 155 lbs. 7 oz. 4 drs. from 745 lbs. 8 oz., there will remain 590 lbs. 4 drs. of vegetable substance; namely, in stalks, fruit, fragments, &c. not eaten by the worms; and subtracting the 590 lbs. 4 drs. from 1362 lbs. that had been laid on the hurdles, it will appear that the worms have only really consumed 771 lbs. 7 oz. 4 drs. of pure leaves. From which statement it ensues,

1. That to obtain a pound and a half of cocoons, it requires about 20 lbs. 4 oz. of leaves, as gathered from the trees; and that it requires 1609 lbs. 8 oz. to obtain 120 *lbs. of cocoons, which an ounce of eggs should yield.*

2. That this quantity of leaves gathered from the tree, deducting 142 lbs. 8 oz. of refuse and sorting, and 105 of decrease, by means of evaporation, it only requires 16 lbs. 8 oz. of pure leaf per lb. of cocoons, or 1362 lbs. for 120 lbs. of cocoons.

3. That subtracting from the 1362 lbs. the 590 lbs. 4 drs. of residue, such as branches, stalks, fruit, &c. which were taken off the hurdles with the litter, 9¾ lbs. of pure leaf have been sufficient to obtain 1½ lbs. of cocoons; and consequently 771 lbs. of leaves effectually eaten have sufficed to obtain 120 lbs. of cocoons.

4. That the 1362 lbs. of leaves distributed on the hurdles, having only yielded 745 lbs. 12 oz. of gross litter, and 120 lbs. cocoons, in all making 865 lbs. 12 oz.; there is a loss escaped in gas, vapour and steam in the laboratory of 496 lbs. 4 oz.

5. That in a laboratory containing the worms proceeding from 5 oz. of eggs, there must have escaped on each of the last six days of the fifth age, 300 or 450 lbs. of gas and vapour, invisibly to the eye.

These latter statements present strong evidence how formidable the enemies are which assail the laboratory, and the need of ventilation.

It is considered astonishing that one single worm, which, when first hatched, only weighs the hundredth part of a grain, should consume, in about thirty days, above an ounce of leaves; that is to say, that it devours in vegetable substance about 60,000 times its primitive weight.

Facts relative to the increase and decrease of silk worms in weight and size.

Progressive Increase.	grs.
100 worms just hatched weigh	1
After the 1st moulting.....	15
— 2d.....	94
— 3d.....	400
— 4th	1628
On attaining the greatest size	9500

Thus have they, within five weeks, increased 9500 times their primitive weight.

Progressive Decrease.	grs.
100 silk worms, when arrived at the highest state of maturity, size, and perfection, weigh	7760
100 chrysalides weigh	3900
100 female moths weigh.....	2990
100 male moths weigh.....	1700
100 female moths, after depositing eggs	980
100 female moths dying naturally, after having laid the eggs, and nearly quite dried	350

Space Statistics. Animals that increase so rapidly in weight, must also increase in size. The infant worm, at the moment it ceases to be an embryo, is only one line, (one-twelfth of an inch,) in length: or its length through its successive periods may be thus stated:

	lines.	inch.
The length of the silk worm when just hatched is equal to	1	= $\frac{1}{12}$
After the 1st moulting its length is	4	= $\frac{1}{3}$
— 2d	6	= $\frac{1}{2}$
— 3d	12	= 1
— 4th	20	= $1\frac{2}{3}$
— 5th	40	= $3\frac{1}{3}$

The length of the silk worm is thus increased forty times within five weeks. But its length, from the period of the largest growth until it changes into the chrysalis, diminishes about two-fifths.

The increase, however, in bulk of the silk worm, throughout its progressive ages, is a matter of practical consequence. All writers on this topic, except Mr. Strong, seem agreed, *jurare in verba magistri*, to follow Dandolo. The latter says, the worms proceeding from one ounce of eggs, should have a space—

	ft.	in.
In the 1st age of	7	4 square.
— 2d	14	8 —
— 3d	34	6 —
— 4th	82	6 —
— 5th	183	4 —

Dr. Lardner increases a little these dimensions. But as, in a case of this nature, too much rather than too little, is the better error of the two, by merely rejecting the fraction, and taking the next greater integer, we furnish the following table, adapted to any quantity of worms, proceeding from one ounce to ten ounces.

	Feet square requisite on the shelves, for worms proceeding from									
Ages.	One Ounce.	Two Ounces.	Three Ounces.	Four Ounces.	Five Ounces.	Six Ounces.	Seven Ounces.	Eight Ounces.	Nine Ounces.	Ten Ounces.
1	8	16	24	32	40	48	56	64	72	80
2	15	30	45	60	75	90	105	120	135	150
3	35	70	105	140	175	210	245	280	315	350
4	83	166	249	332	415	498	581	664	747	830
5	184	368	552	736	920	1104	1288	1472	1656	1840

Mr. Strong of Germantown, from an experiment with five ounces, furnishes from the seventh to the thirty-third day, the following statement, by quoting the number of hurdles requisite *each twelve square feet.*

Days.	Hurdles.	Days.	Hurdles.	Days.	Hurdles.
7	11½	16	34	25	70
8	13	17	34	26	70
9	13	18	34	27	87
10	13	19	34	28	87
11	13	20	34	29	87
12	18	21	34	30	87
13	27	22	51	31	90
14	27	23	51	32	108
15	30	24	70	33	112

CHAPTER III.

ON THE REARING OF SILK WORMS FROM THE FIRST APPEARANCE OF THE LARVA UNTO THE CHRYSALIS OR COCOON.

In the preceding parts of this work we have already attended to the preparation of the food, the house, the establishment, and furniture for the insect family, that, for five or six weeks, we intend to be our summer guests, and we have not been negligent in giving precaution against the contingencies that might assail it from disease or vermin. That family, after the hatchment, to which also we have paid due attention, is already announcing its approach on our threshold; and the all-important question is, if it is ready to partake of our bounty, and repay us liberally in silken wealth, are we equally so, to satisfy, to the utmost, its physical wants, and to protect it against the insidious enemies, visible or invisible, to which it is liable.

The food necessary to supply its wants, and the

means requisite to maintain its health, must become prominent parts of this chapter. In a word, *la table d'hôte*, the air, ventilation, temperature, and all the etiquette of daily service, must constitute the parts and parcels of the panoramic evolution now before us. Perhaps we had better put something of the latter first, since, when health is wanting, the host has little to do in the market; for when the doctor is wanted, the cook has a holyday.

Notwithstanding our propensity to vituperate the men of two thousand years ago, for their heathenism, superstition, &c., their common sense maxims, unaltered in validity to this day, are often, against our resolutions to the contrary, occurring to our recollection. "*Est modus in rebus; sunt certi denique fines, quos ultra, citraque nequit consistere rectum.*" There is a medium (a middle path between two extremes) in all things; in short, there are certain limits on either side of which, rectitude (prosperity or success) cannot exist. By observing which "*aurea mediocritas*," golden mean, we may in ninety-nine cases out of a hundred, escape the Scylla on the one hand, and the Charybdis on the other.

If we peruse the works of European culturists, we read the works of men that have to combat with the north-western blasts, nearly three-fourths of all that blow in the year, that sweep the immeasurable vapours of the Atlantic on European shores. Hence we hear of the artillery of their thermometers, thermometrographs, barometers, hygrometers, pluviometers, eudiometers, flash-fires, and all the paraphernalia of a *Dandoliere*. Here is one extreme; suitable indeed, at least to western Europe, and for some parts, even this is scarcely sufficient. On the other hand, the extreme, the unparalleled felicity of this climate, by some is so preached up, a climate so isothermal with that of China, where silk worms, as some dream, will live and thrive, whether any attention is paid to them or not, as if here care as to temperature is never necessary, whether a similar season to the year

1816 should occur again or not, or without inquiring at what degree all the liquid gum in the secretors of the insect congeals, when all its previous toil, without an instant restoration of warmth, is rendered nugatory and useless.

Unless we can in all climates of this Union from Maine to Louisiana, and in all years, through May and June at least, promise ourselves a temperature not less than 75°, the use of a thermometer, and of means requisite, if necessity exist, of raising the temperature to that degree, is advisable. Count Dandolo, in giving us his prescript, as to the successful rearing of the silk worm to the cocoon says, "I must suppose that the silk worms are kept until the first moulting at 75° of temperature; between 73° and 75° until the second moulting; between 71° and 73° until the third; and lastly between 68° and 71° until the fourth moulting." One of the foundations of the art of rearing silk worms is to know the various degrees of heat in which the silk worms should live; if this precept be not enforced, nothing can be performed with exactness.*

* On this subject the writer of an article on silk worms inserted in M. Rozier's Course of Agriculture, Paris edition, 1801, thus expresses himself relative to heat suitable to the constitution and operations of these industrious animals.

"It cannot be said that silk worms are injured by any degree of heat in these climates, however considerable it may be. Native of Asia, it must needs be accustomed to heat more intense than it can experience in Europe. But the sudden changes from moderate to violent heat, or the reverse, are injurious. In its native climate it is not exposed to those vicissitudes, and, therefore, thrives well, without requiring all the care we are obliged to bestow on it. We must not lose sight of the fact, that it is not heat that affects the silk worm, but sudden transitions from one temperature to another. Such as making it pass from 68° to 77° in one day. If it be necessary to hasten the worms in consequence of the advanced state of the mulberry leaf, which cannot be retarded, it should be done gradually, so that they perceive not the alteration. M. Boissier de Sauvagues will show us by his experiments, to what degree the heat may be raised in rearing silk worms, without fear of injuring them. 'One year, when hurried by the early growth of the mulberry leaves, which were developed towards the latter end of April, I gave the silk worms 100° of heat during the two first

On the subject of the amount of food necessary to be given to any given quantity of worms, Mr. Comstock says, "though we have not much faith in feeding worms by arbitrary mathematical rules, yet as they may be of some practical use to the culturist, in ascertaining the amount of food necessary to be provided for his family of worms, we give them, in brief extracts, from the manual published by authority of Congress in 1828. In doing this, we shall give the amount prescribed on each consecutive day of

days after hatching, and about 95° during the remainder of the first and second age, there elapsed only nine days from the hatching until the second moulting inclusively. The walls and wicker hurdles were so heated that they could scarcely be touched. All thought they must perish; but all went on well, and to their great surprise, I had a most abundant crop. I afterwards tried giving the silk worms in their first age from 93° to 95°; 89° to 91° in the second age, and it is remarkable, that the duration of these two ages was nearly similar to that of the preceding experiment. It is singular that these worms thus hastened in their two first stages, consume only five days in moulting the third and fourth time, although with only a temperature of 82°; whilst those worms that have not been hastened, take seven or eight days for each of the two last moultings in an exactly similar degree of temperature. It appears sufficient to have given the constitution of the insect an impetus to regulate the quick succession of its changes. This impetus which we have described, as productive of such accelerated growth, also gives the insect additional vigour and activity, which they preserve through their after ages, and prevents diseases. Thus the hastened or forced cultivation presents a double advantage. It also shortens the care and attendance necessary for silk worms, and sooner terminates the solicitude of the cultivator, who must necessary feel anxiety until the cocoon is gathered. To follow this method it is requisite to observe well the advancement of the season; the shooting of the mulberry leaf, whether it is checked by cold; if, again, the growth of the leaf is delayed, and the heat should soon after set in, and ripen it more quickly than was expected, it would be advantageous then to hasten the worms by heat; for if they are allowed to delay from want of heat, their first age is prolonged, and the mulberry leaf will grow, and harden, and become unfit for them. The essential point is that their progress should follow that of the mulberry leaf. If cultivators adopt this method, they must put the eggs to hatch ten days later than they would require to be laid to hatch in the ordinary way. And they must calculate the duration of the different ages of the worm, and so manage that the completion of the rearing or fourth age should fall into the time in which the leaf has attained its full growth.'"

their life, without regard to the day of their respective ages."

But that work as well as every other manual published in this country, are evidently derived from the canons of Dandolo: and what is certainly very singular, every one of them appears to be under a complete misconception relative to the number of worms for which the prescript of our Italian oracle is given. Hence Count Dandolo, Count de Hazzi, and M. Bonafoux, have been understood as prescribing different quantities of leaves for the same number of worms. Whereas a little investigation would have shown that instead of discrepancy, the *different*, not the *same* number of worms as most imagine, they contemplate being considered, there is evidently a remarkable agreement in the three authorities quoted.

To show, however, that some discrepancy in their proportions have been commonly understood, it is only necessary to quote as follows from Mr. Comstock: "Count Dandolo calculates that 200,000 worms will consume 7000 lbs. of leaves. Count de Hazzi calculates that the same number of worms will require 10,000 lbs. of leaves. Mr. Bonafoux says that 200,000 worms were sustained by 7217 lbs. of leaves. The quantity, however, given them between the regular meals was not taken into the account, and the leaves were chopped during the first stages, which enables the worms to consume them with less waste."

We now arrive at another version of Count Dandolo's meaning, in Mr. Roberts' Manual, where we read, "the quantity of food is the proportion given to the worms hatched from five ounces of eggs, which according to our reading, means 100,000!" Here is discrepancy, the one supposes the count, by five ounces, to mean and provide for 200,000 worms, the other for only 100,000! How ungracious must this said count have been, to put our mathematics to so severe a test as to divine what number of worms he really did mean by five ounces of eggs.

Though the count does not inform us of the number of worms of the feeding of which he furnishes us an example, yet his statistics are clear, and will afford data sufficient to satisfy such further inquiries as are necessary. They are founded on a basis, fixed, from which, in general illustration, he does not swerve, that whilst it serves as a well defined unit, in consequence, admits of variations such as the contingencies he supposes may occasion. Hence we are duly informed that in the example given for general instruction, the experiment is not with the small worm of three moultings, for then should we have 42,620 eggs to the Milanese ounce; nor yet with the large silk worm obtained from Friuli, when our calculations would have reference to 37,440 eggs to the ounce; but to what he defines as the "*common silk worm of four moultings*," whose eggs he invariably quotes at 39,168 to the ounce of Milan. This, then, is the *common measure*, or measuring unit of the count's statistics, and to which his subsequent proportions refer. It is not 39,168 worms, but 39,168 eggs; and how many of the former the latter will be, we are duly informed will depend on circumstances, not merely on the quality and preservation of the eggs, but on our careful and vigilant attention, not only in the hatch, but in the whole management of this interesting and profitable animal. From this unit, *this starting place*, we are, then, guided by a skilful hand, and our next step is to know that the quantity to which the count's feeding proportions refer, is the worms *proceeding from* five ounces of the kind of eggs specified. Hence the assumption is not warranted that the Italian experimentalist is giving us a lesson on feeding five times 39,168 or 195,840 worms, much less 200,000, as some have supposed, as if 40,000 were the proceed of an ounce; nor is there on the other hand, any need, in making liberal allowances for negligent culture, to sink so low in the calculation, as to suppose that five ounces will only yield 100,000 *surviving* worms, or 20,000

to the ounce, provided that we devote to the undertaking any thing like the almost paternal care of the patriarch Dandolo. He that manifests devotedness like his to any grand object of *national* industry, is questionless the true patriot; a word, whether derived from *pater* or *patria*, in spite of our etymological subtleties, implies some thing *parental.* We are aware of the allowances to be made for the occasional foibles of every devoted parent: we have made them; we have rejected the chaff and retain only the wheat; and have the *offspring, the silk culture*, of full stature and healthy condition, and such as is capable of the reproduction of its own like in these transatlantic climes.

After making these allowances, we are prepared to say, that out of all the numerous authors on this subject, whether of Asia, Europe, or America, with which we have long been acquainted, we know of not one to whom he is second. All the rest are either copyists, or the care, the minuteness, the science, they exemplify, will admit of no comparison with those of the archetype of Varese. It is, perhaps, time, therefore, that he should speak for himself.

At page 195 he says, "The result of my experiments proves that 360 silk worms, produce about one pound and a half of cocoons." Therefore 240 silk worms of the kind, constantly *implied*, and fed from the white mulberry with the care he supposes, yield, on the average one pound of cocoons. And from this doctrine he does not vacillate throughout the whole of his statistical inferences. Deviations, indeed, he supposes possible, but they are always considered by him as the result of some corresponding variation from the management, the example of which he proposes to our view as the standard. We thus, therefore, obtain a kind of measuring equation, which will enable us to decipher not only the contingent fluctuations above or below the zero, which he contemplates as the standard, but also to ascertain the number of *surviving*

worms which he evidently supposes, whether from one, five, or any other number of ounces, to be variable and not fixed, unless the conditions he specifies be fulfilled.

On this point his language is sufficiently definite. "I must make a few general remarks on the enormous difference in results, which real care," or the want of it, "produces. I do not here mean to allude to the slight and partial differences, that may be considered as only exceptions and accidental, but of those which are *caused by ignorant and ill-directed management.* Hitherto it has been generally thought, in quoting facts and experiments, that whatever were the quantity of eggs intended for a laboratory, the quantity of cocoons never bore any proportion to that of the eggs; but that on the contrary the greater the quantity of eggs, the less the proportion of cocoons." This is, questionless, an exposé of the mismanagement and negligence existing even in the silk districts of Italy, before Dandolo taught there a more correct and philosophical doctrine.

"These differences it should be known, do not depend on the organization or natural condition of the silk worm, but *are solely to be ascribed to error and ignorance.* Facts, and most evident reason surely prove that, if the silk worms have had space, if the degrees of temperature have been exactly regulated, if the necessary quantity and quality of food have been given, and that all the care I have recommended has been practised, *the quantity of cocoons should be and always will be, proportioned to the quantity of eggs* that were hatched. *Those who do not obtain this result should attribute their failure to the erroneous system they have adopted.* My laboratories are of various sizes; that which I am going to describe is calculated for the reception of *the worms proceeding from five ounces of eggs.* The other laboratories equally yield cocoons in proportion to the eggs which I have hatched."

"I should allow the advantage of my manner of rearing silk worms to be most trifling, if it were only in the produce of the 110 or 120 lbs. of cocoons from each ounce of eggs, which others obtain, consuming the same quantity of leaves, and differing only in the hatching of two ounces of eggs. But as I said before, the great and principal aim of the art of rearing silk worms, is to obtain from one given quantity of mulberry leaves the greatest possible number of cocoons of the finest quality. It is not the trifling loss of an ounce of eggs which should induce a change of system, but the following advantages: for it is a true fact, that

"1. When, with one ounce of eggs, 110 or 120 lbs. of cocoons are obtained, about 1650 lbs. of the mulberry leaf will be used.

"2. That when only 55 or 60 lbs. of cocoons are produced from one ounce of eggs, about 1050 lbs. of mulberry leaves have been used." *Under this supposition it would appear that* 2100 *lbs. of leaves are requisite to produce* 110 *or* 120 *lbs. of cocoons!*

"3. That 110 or 120 lbs. of cocoons obtained from one ounce of eggs, are worth a great deal more than a similar quantity procured from two ounces of eggs. It is easy to prove these facts rational.

"I stated that 39,168 eggs, which constitute one ounce, might produce about 165 lbs. of cocoons." That is on the supposition that the 39,168 eggs become 39,168 worms, and that they survive, and produce each a cocoon.

"If, on this statement, we consider the loss of worms to be great, when we obtain only 120 lbs. of cocoons from one ounce of eggs, the loss will be essentially greater, should we only obtain 60 lbs. It is natural to suppose that by this *greater mortality*, a greater consumption of leaves should result, as the worms which do not reach the consummation of the cocoon, feed more or less, as well as those which accomplish the cocoon.

"The great mortality of the worms must also affect the quality of the cocoon. *For who could suppose that two-thirds of the worms proceeding from one ounce of eggs should die without some error or want of care?* In this case, are we not justified in thinking that part of those that remain are weakened and injured? This inference would be still more forcible, if, as it frequently happens, that the 60 lbs. of cocoons be reduced," (what, in Italy?) "to 45, to 30, 15 lbs., &c.

"Whereas, if one ounce of eggs should produce, by the means I have stated, 120 lbs. of cocoons, *they will be fine, and will sell well.* 360 worms will produce 1½ lbs. of cocoons, (i. e. 240 to the pound,) and 11 or 12 ounces of these cocoons will yield an ounce of exquisitely fine silk. But when only 50 or 60 lbs. of cocoons proceed from an ounce of eggs, it may be generally presumed that they are of inferior quality and not so valuable, and that it will require 400 at least to make 1½ lbs., (about 267 worms to one pound of cocoons,) and above 13 ounces of these cocoons, instead of 11 or 12 ounces, will be wanted to form one ounce of silk.

"Moreover, when the worms have not been properly managed, there is no certainty as to the quantity of cocoons that will be gathered; and it happens continually, that the same cultivator will, from the same quantity of eggs, and the same quality in the leaves, obtain at one time a number of cocoons, at another time few, and sometimes none. It would be interesting therefore, as well to the government as to the individual, to compare the quantity and quality of the cocoons produced on my plan with those produced on the system which is generally adopted. If it were afterwards calculated, the loss occasioned by ignorance every year would doubtless cause astonishment."

Independently of the valuable information of practical consequence, that we gain through these remarks, we also learn that the count's ratio between

the number of worms that arrive at maturity to spin, and the weight in Milan pounds of cocoons is 240; that is, if the whole be conducted with that degree of skill and care, which is necessary to constitute the medium, the unit of statistical calculation, and that to which the count's proportions, given in the diary, constantly refer. And as he also reckons, on the same condition, on 120 lbs. of cocoons to the ounce of eggs, it is evident that he is supposing that he is making a continued provision for 120 times 240 for every ounce of eggs in his laboratory; or for 28,800 *surviving* worms proceeding from the 39,168 eggs that constitute a Milan ounce; which makes the ample allowance of 10,368 for such contingency and mortality as might occur, on the average of seasons and circumstances, even under the unremitting vigilance of a Dandolo. Now as he here expressly informs us that he is making provision for five such ounces, or five times 28,800, and since he elsewhere, at least, twice says, that experience authorizes him to expect from such an example as he presents us for general illustration, 600 lbs. of cocoons, which as before observed are at the rate of 240 worms to the pound, from these separate and distinct premises, $240 \times 120 \times 5$, and 600×240 we arrive at the same result, viz. 144,000 *surviving worms, or the worms which out of five Milan ounces of the eggs of the common silk worm of four moultings will, with the very practicable care, and laudable zeal of Dandolo, on the average of seasons and circumstances, ultimately, spin cocoons.* But it is here unnecessary to reduce these Milan pounds or ounces, or the number of eggs or worms to which they refer, to English ounces or pounds; since as the quantity of leaves prescribed for each day, is administered by the same kind of weight, the proportionality will be not disturbed. Hence the quantity of leaves prescribed for every day of the diary of Count Dandolo, is neither for the 200,000 worms seen through the *convex* glasses of Judge Comstock, nor for the 100,000 viewed

through the *concave* lens of Mr. Roberts, but for the 144,000 surviving worms *predestinated* not by Calvin's but by Dandolo's *decrees*, under implied circumstances, out of five Milanese ounces, to spin cocoons. With this understanding we shall find that the proportions prescribed respectively by Count Dandolo, Count de Hazzi and M. Bonafoux, are consistent, and are not either discrepant or contradictory as they have been erroneously represented. *The whole consideration terminates in the simple result that* 10,000 *lbs. of* WHITE MULBERRY LEAVES *are necessary, during the five weeks of feeding for* 200,000 *silk worms; and consequently one pound of the same kind of leaves are requisite for every* 20 *worms. That is,* 350 *grains at least to constitute from* 68 *to* 73 *grains in the substance of the insect at its maximum size; and therefore* 12 *lbs. of white mulberry leaves, at least, are necessary, to produce one pound of cocoons, and between eight and nine times that quantity, or* 100 *lbs. of the same leaf, to yield one pound of silk.*

After these preliminary observations it is now requisite that we turn our attention to our young family, which by this time will have important claims on our services. Prior to our entrance into the cocoonery of a large scale, or one of five ounces, the count gives an example of a smaller establishment, or the laboratory *of a single ounce.* Of this, since in certain cases, it may have its use, we shall here give the outline.

The silk worms *proceeding* from *one ounce* of eggs consume

IN THE FIRST AGE; 6 lbs. of *white mulberry* leaves well sorted, and chopped very small; to which 5 lbs. of the leaves of the *morus multicaulis* will be equal.

IN THE SECOND AGE; of the *white mulberry leaf*, they consume 18 lbs.; sorted, clean, and chopped rather more coarsely than in the first age; of the *multicaulis* leaf, about 15 lbs.

IN THE THIRD AGE; of the *white mulberry leaf*,

they consume 60 lbs. well sorted and less chopped; of the *multicaulis* 50 lbs.

In the fourth age; of the *white mulberry* leaf, 180 lbs. well sorted and still less chopped than that of the third age: of the *multicaulis* 144 lbs.

In the fifth age; of the *white mulberry leaf* 1100 lbs.; of the *multicaulis* 880 lbs.

The above, of course, is given as a general rule, or one on the supposition of ordinary circumstances and care. We are informed that even a variation in the season will have an influence on the requisite quantity of leaves. If the leaf be injured by the season, and the proportion of nutritive matter it contains lessened, a greater quantity to produce the same effect will be necessary; and vice versâ, if the nutritive proportion of the leaf be increased, a quantity less than the medium prescribed will realize the hopes of the culturist.

The above will serve as an outline of manipulation on a small scale. In following out the detail, however, for the sake of variety, we will repair to the large laboratory, or establishment *for worms proceeding from five ounces of eggs.*

For small quantities, of course, as already observed, spare buildings or apartments, may often serve; but we must now suppose the previous building of a regular cocoonery, of which we have already given an example. It is proper that at the commencement, the shelves should be numbered, 1, 2, 3, 4, &c. throughout. The quantity of eggs to be hatched ought not to be more than will leave room, within the cocoonery, and according to the number of shelves that we can conveniently furnish therein, sufficient for the full development of the worm, or for their accommodation at their utmost growth.

The eggs should have been divided by weight into ounces or half ounces, and each parcel kept apart. It would be better, supposing the number of shelves to be 30, 35, 40 or upwards, to divide into half ounces, and so to apportion them, as to leave a number of

spare shelves; and if the eggs be good, and the produce more than an average, to distribute them into more space than they would ordinarily occupy. But the distribution on the shelves according to the order or date of their hatching, and according to distinctive numbers on the shelves and as duly recorded in a diary, which will be kept by every accurate culturist, should be observed throughout.

We have already remarked that several recent authors have estimated from 35,000 to 40,000 or even upwards to the ounce; and we have seen that Count Dandolo quotes the definite number of 39,168 eggs of the common silk worm of four moultings to the Milan ounce; of which, it is evident, that the whole of his prescriptive measures are proportioned to the supposition, that with the standard treatment, he sanctions 28,800 worms will survive to the cocoon, which we have already determined to be equivalent to 36,244 eggs and to 26,650 *surviving* worms to the English ounce avoirdupois. In the application of space, this latter number is to be regarded as a necessary element in our calculation; but as it is quoted as a *medium*, and a contingent deviation, if any, might be in our favour rather than to the contrary, it will be acknowledged that of too much or too little space, an appropriation of the former, will be the less evil of the two.

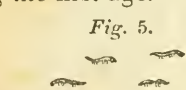
With this allotment then of space, which in all cases should be such, that there be no necessity for the worms touching one another, we may suppose that the worms are now properly distributed on the shelves, and each in the enjoyment of as much or more space around, as its exclusive province or principality, as existed in the sweep of the eye of Thompson's insect on the dome of St. Paul's cathedral. All things then are ready, and we expect that the superintendent is more than ready, and has counted, long since, the heads of his future manipulations, on the tips of his fingers, as accurately as the Roman orator.

We see him then at work. The panorama of the

cocoonery, the *tout ensemble* is before us. We see that zeal, the spirit of his office, actuates the man; which whilst it is the logic that suits his own pocket, benefits the nation. Patriotism, or even a nondescript philanthropy, not provided for by Linnæus, often effects the most, when it begins with a little thing, an *insect for example;* and here even selfishness, how ever paradoxical, must benefit another! This zeal, we perceive, has dictated to this superintendent the propriety of a book of record, a diary, a book of memoranda, or a faithful register of every event, each according to its respective date, of every thing that can concern the hatch, or hatches, if he have more than one, the moultings, the ages or quantity of leaves administered during each, the temperature, in short, every occurrence, especially of a statistical character, that can be comprised within the whole history between the egg and the reel.

Leaves are now to be thinly scattered over the shelves. It is not absolutely necessary that the hurdles should be used till the third age. The young larvæ will run about, and leave the shelves, if food be not given them immediately after their exodus from the shell. They will never leave the feeding shelves till they rise to spin, provided that they be duly supplied with food, proper in quality, sufficient in quantity, and at the time they require it. The following cut represents the worms just emerged from the shell, during the first age.

Fig. 5.



REARING OF THE WORMS.

First age: *First day.* To the worms proceeding from five ounces of eggs, on the first day of their existence in the larva state, are to be given, in proper proportions, at successive meals, two hours apart, of the *white mulberry leaf,* about 3¾ lbs., chopped very small; giving the smallest quantity for the first feed-

ing, and gradually increasing the quantity at each successive meal; of the *multicaulis* leaf, the quantity may be 3 lbs.

The benefit of giving the leaf, at this early stage of the worm, in a state of minute division, by chopping, is evident. The more the leaf is chopped, the more fresh cut edges exist, on which the little mandibles of the infant operatives can fasten. In this state, they bite the leaf quickly, and consume it before it is withered.

If care be not taken thus to chop the leaf small, and to give the young worms sufficient space at first, and more as they need it, a greater number will be liable to perish, by disease, or from difficulties they want strength to encounter at an age so early. The worm that cannot eat, dwindles, becomes extenuated, weak, and unsupported, and, consequently, perishes under the leaf.

Count Dandolo fed his worms regularly four times every day. From this medium, in practice, there are at least two variations. Some give the whole quantity for the day at once! This mode is liable to several objections; others divide Dandolo's four meals into from eight to twelve, which, we think, gives an indication that the party is determined to realize good cocoons. The worms, too, should be fed not only *by day*, but *by night*. Whatever number of meals are given during the twenty-four hours, it will be easy to give the whole quantity of leaves prescribed for the day, in corresponding proportions.

Second day. On this day, of the *white mulberry leaf*, give, at four regular meals, about 6 lbs. chopped very small. Let the first meal be the least, and increase gradually to the last: of the *multicaulis*, give about 5 lbs.

There will now appear some evident change in the appearance of the worm. It begins to lose its dingy and bristled aspect, and the head perceptibly enlarges and whitens.

Third day. Give at four meals this day, of *soft*

white mulberry leaves, chopped very small, about 12 lbs.: of the *multicaulis*, about 10 lbs. The worms are now feeding with avidity. The head of the worm continues to become whiter, the insect to grow larger, the former bristly appearance to vanish, and the skin is assuming a sort of hazel colour. When viewed through a convex lens, their surface looks shining, and their head, a silvery white, somewhat like mother of pearl, and transparent.

Fourth day. As the worm approaches the moulting, a diminution of appetite occurs. Of the *white mulberry*, give about 6 lbs. 12 oz.; let the first meal be about 2 lbs. 4 oz., and the rest gradually decrease to the last. Of the *multicaulis*, give about 5½ lbs. And let it be remembered, that in this first age, it is of importance to give the insects plenty of room, by gently separating and spreading them, to avoid as much as possible their sleeping, on the verge of moulting, in heaps.

At the beginning of this day, the first appearances of the approaching change are indicated. The worms begin to shake their heads, and thus express uneasiness at the increasing tension of their skin. Some are now eating very little; keep their head in an elevated position; their body appears transparent; those nearer the moulting time, when seen against the light, are of a yellow, livid tinge; but the greater number, at the close of the day, appear torpid, and cease to eat.

Fifth day. Of the young leaves of the *white mulberry*, 1½ lbs. only, chopped small will be sufficient. These chopped leaves scattered lightly on those parts of the shelves, where worms appear to be still feeding. Of course, where variations from the general state be perceived, and some are still willing to eat, more leaves may be given. The discretion of the careful superintendent, here and in all similar cases must be exercised.

Towards the end of the day, however, in the general case, the worms are torpid, and a few begin even

to revive. After the first moulting the silk worm is of a dark ash colour, showing distinctly a peculiar vermicular motion, and the rings that mechanically assist that motion contract and dilate their intervening distance more freely than before.

When the weather admits of it, the leaves should be gathered several hours before the meal is given; they last very well a day, and more if kept in a damp cool place.

General remarks on the first age.—The first age of this industrious animal, at the temperature here assigned as a medium, is almost always one of five days. In this age the silk worms proceeding from five ounces of eggs have, of the *white mulberry* consumed about 30 lbs. sorted, picked and chopped leaves. If the refuse of the leaves picked off and rejected be estimated, its proportion will be about 4½ lbs. making the quantity taken from the trees to be in all 34½ lbs., or about 7 lbs. of leaves to each ounce of worms. In this age, the air of the cocoonery should be renewed only by opening the doors.

Second age.—About 73 ft. 4 in. square of shelf space will be, for the accommodation of the growing family proceeding from 5 ounces necessary until the accomplishment of the second moulting, or completion of this second age. These, as before observed, should always be covered with strong paper, or proper pasteboard. The temperature during this age, as recommended by Dandolo, "*should be*," says he, between 73° and 75°. *Prescribing* as to temperature in a hot country in juxtaposition with June or July, appears of course, a little arbitrary; a subject, for want of room here, we shall further consider in the subjoined note.* The insects should not be raised

* We must remember that Count Dandolo wrote in the northern parts of Italy, between the elevated regions of the Alps on the one side, and the Apennines on the other; by the fanning breezes of whose snow capt tops, and his ventilators, what cooling zephyrs Dandolo could *command*, we poor panting lizards in an American July know little. It has been very properly asked, how are we to *command* the temperature

from their litter until they are nearly all revived. There will ensue no detriment if we wait till nearly all discover a disposition to move, even should it be for twenty or thirty hours from the time when they first began to revive.* Important changes are

to walk down to 73° or 75°, when even in the shade without, the thermometer is raging from 90° to 100°. At this time little current exists in the external air, and consequently all common ventilators are then of little promise. This reminds us of an admirable convenience in common use, particularly amongst the affluent voluptuaries in Bengal and India, but as yet too little known in this country. Since there, even in the latter part of January, the thermometer sometimes rises to 90°, we may easily conceive what the tropical temperature of India frequently is in the months of June, July, and August, especially to those, whose means allow them not the luxury of spending their days under the *punkha*.

The *punkha* is a large frame, or in longer rooms, frames of wood, each covered with painted canvass, and so caused to be suspended by ropes, or to swing on hinges, that when the one is moved, they all oscillate with the same pendulous vibration, and according to their extent of surface, *command*, a less or greater current of air in the room. It is generally hung over the dining table, and is there intended to answer the end of a fan. In India, a servant stands on one side of the room, and holds the rope, fastened to the middle of it, and keeps drawing the punkha to him, and then letting it go again. In this manner, the air being agitated, the region under the punkha becomes comparatively cool. In hot weather, some Europeans sit under the punkha from morning to night, and put their couch under it, in the day, when they take a nap. We understand, also, from respectable authority, that the flies, musquitoes and gnats, that prowl in the air, and take the liberty, without asking leave, of going a pilgrimage across the Indian aristocrat's nose, when he is enjoying his afternoon sieste, are particularly opposed to this innovation of their privileges. Several of these punkhas are kept going in the mission church at Calcutta during divine service. A valuable hint for American churches, in June and July. An evident improvement would be, instead of using a servant, to let the whole move by a pendulum. When a current is sufficiently produced in the cocoonery, stop the pendulum, or set it agoing when wanted, *ad libitum*. (If we can persuade our friend, who talks of manufacturing an improved pattern of the punkha, he will send it to the cocoonery office, or establishment of the Morodendron Silk Company, for inspection. It is time that we Americans, in our houses, our courts, our churches, our cocooneries, in June, July and August, should know the value and use of the *Indian punkha*.)

* During the first age too many cultivators destroy the health and life of a number of worms for want of sufficient attention; and consequently beyond that age, they have worms of unequal growth and advancement, an inconvenience never after remedied. This inequality and the evils

effected by the first moulting. The organs assume greater consistency. The scaly muzzle which they lose by moulting is replaced by another which the air indurates; and till the small jaws or mandibles have acquired sufficient hardness, they cannot, in certain cases, with an expedition equal to what their seasonable advance to maturity requires, divide the leaves. With the aid of a convex lens, we immediately perceive the efforts, to the expense of which, an *unassisted* worm of this age, is liable, in gnawing the leaf.

Sixth day. Of the *white mulberry* give now 9 lbs. of young tender shoots, and 9 lbs. of leaves, well picked and chopped small.* Of the *multicaulis* this is equal to 15 lbs.

Experience has proved that the silk worms like the tender boughs so much, that they remain crowded on them even when the leaves are consumed, and evince a reluctance to return to the litter below. This remark will doubtless afford a hint to the provident culturist in affording the requisite accommodations for the health and comfort of animals that repay in proportion to the care expended on them. When the worms

resulting from it, are caused, 1st, By not having placed the silk worms in space proportional to their growth in the course of their first age, which has allowed of some feeding well, whilst others could not feed, of some remaining under the litter, others on it, the latter having the benefit of free air, the former not. In moulting, if those that moult sooner than others, and are under the leaf, this important change is retarded. 2dly, By not having placed the sheets of silk worms hatched on the first day in the coolest parts of the laboratory. 3dly, By not having placed the latest hatched worms in the hottest parts of the laboratory. 4th, And lastly, by not having given the last hatched worms intermediate meals, to bring on their growth a little faster.

* In recommending that the leaves be *chopped small*, we are rather inclined to follow experienced culturists in Europe and America than our own judgment and experience in the matter. We think, excepting perhaps in the first age, that *nature* has furnished the silk worm with means to devour food, if they can get it, whether chopped or not. Their own choppers are machines which never fail them. But in some cases *nature* may be improved upon, more especially if *art* and *nature* are combined.

have been removed to clean hurdles, those they have left should be thoroughly cleansed.

From the first day of the rearing of silk worms, until the first moulting, these insects have consumed 30 lbs. of leaves; 22 lbs. 8 oz. have contributed to their growth, or have evaporated in the first age. The worms void a small portion of fœces resembling fine black powder, of the 7 lbs. 8 oz. of remaining substance there are only about 10 oz. of excremental matter.

Seventh day. Of the *white mulberry* give 30 lbs. of chopped leaves; divided into four portions to be given at intervals of six hours; but an improvement would be to divide into ten or twelve portions, given at intervals of two to three hours each. The first meals less plentiful than those which follow. Of the *multicaulis*, this quantity is equivalent to 24 lbs.

The body of the worm now acquires a clear hue; the head enlarges and becomes whiter. Continue to pay an unremitting attention to the equal distribution, as to space, of the worms. Place boughs wherever they appear to be too thick, on which they will immediately fasten, and may thus be removed or distributed to fill up places not sufficiently covered.

Eighth day. Give now, of the *white mulberry* 33 lbs. of chopped and well picked leaves; and at this time let the two or three first meals be the largest. Of the *multicaulis leaves*, give 27 lbs. These leaves, distribute at each meal with attention, and as far as possible proportionate to the degree of avidity discoverable by the worm; since it becomes again the period when the voracity of the worm, consequent on the approach of the second moulting, begins to abate, which they soon indicate by the usual prognostics of rearing their heads and declining to eat.

Ninth day. Of the *white mulberry*, 9 lbs. only of picked leaves and chopped small, will be required, distributed in the same manner as before. Scatter the proportions lightly, and with discriminat-

ing care over the worms. *Of the multicaulis*, about 7 lbs. will be sufficient.

On this day our metempsychosin insect, which seems almost to have been the primitive instructer of the Samian philosopher, is again discovering its periodic restlessness for change. It is sinking into a torpor. The next day its old wardrobe is disposed of, and it becomes as eager or more of its third life, as it was of the first.

Fig. 6.

GENERAL REMARKS ON THE CONCLUSION OF THE SECOND AGE. In the four days of this age our young colony has consumed about 90 lbs. of picked leaves of the white mulberry. If to this we add a refuse of 15 lbs. rejected from the picked leaves, 105 lbs. have been drawn from the trees, that is, at the rate of 21 lbs. for every ounce of silk worms. To these three proportions, 72 lbs., 84 lbs., and 17 lbs. of the multicaulis respectively correspond.

Their colour now is become of a light grey, the hair has become so much shorter as to be hardly perceptible to the eye. The muzzle, which in the first age was very black, hard and scaly, became immediately on moulting white and soft, now becomes again black, shining and shelly as before, and as the insect becomes older, at each moulting, its muzzle hardens, because it needs to saw and bite larger and older leaves.

THIRD AGE.—*Tenth day.* Give of *white mulberry* 15 lbs. of small shoots and 15 lbs. of the picked leaves, chopped small. At the close of the age, they may be more coarsely chopped. To this quantity, 24 lbs. of the *multicaulis* are equivalent.

The worms that have accomplished this age should not be removed from the shelves until they are nearly roused. Part will rouse on the ninth and part on the tenth day. No injurious consequence will ensue, if the

part that has revived should wait 12 or 15 hours till the rest are ready. A never failing sign that they are roused is the undulatory motion they display with their head, when horizontally blown over.

It will ever be incumbent on the superintendent, or person who has a leading interest in the concern, frequently to inspect the operations of the feeders, to see that the food is at all times equally distributed, according to the varying wants on different portions of the shelves. Redundant leaves, though a loss, is still an inconvenience less than the accumulation of an unnecessary portion of litter, which may ferment and produce noxious evaporation and disease.

Eleventh day. Of the *white mulberry*, give at separate meals 90 lbs. of picked and chopped leaves; of the multicaulis 72 lbs. The first meals should be the least; the reason of this, the worms themselves will explain, since it is in the latter part of the day, that they now become voraciously hungry.

Twelfth day. Of the *white mulberry*, 97 lbs. of picked leaves will be wanted, chopped and divided into the usual number of meals; the first being most plentiful. Towards evening, the hunger begins to abate, the last meal therefore on this day should be the least. To this quantity, of the *multicaulis*, 78 lbs. will be equivalent.

The worms now grow fast; their skins become whiter, their bodies semitransparent, and their heads longer, and the contortions they make show that their change approaches.

Thirteenth day. 52½ lbs. of chopped *white mulberry leaves* will now be sufficient. 42 lbs. of the *multicaulis.* Give in the usual number of meals, the largest first, the last meal the least, feeding those only that require it. Should a greater number of silk worms on one table be torpid, whilst others continue to require food, give only a slight meal without waiting for the stated hour of feeding, in order to satisfy them, that they may sink into torpor speedily. Care of this kind is important, and intermediate meals oc-

casionally given, and by discretion administered, is beneficial.

Fourteenth day. Of the *white mulberry*, 27 lbs. of picked and chopped leaves will be sufficient, in ordinary cases, more or less, as occasion requires. To this medium supply, of *multicaulis* leaves 22 lbs. will be equivalent. Indications of silk now begin to appear from the occasional depositions of the insect.

The worm now manifests inclination for solitude and free space to slumber in. It either climbs the edge of paper, the elevated stalks or leaves, or in failure of that, on the litter; it rears its head and expresses its uneasiness. Immediately on the verge of change, they void all gross excrementitious matter; a yellow and semitransparent lymph only occupies the intestinal tube, and constitutes nearly the only fluid remaining in the animal. This also is that which prior to their change gives them a yellowish white colour like amber. Whilst the worms thus prepare for the moulting, sufficiently clear, by moderate ventilation, the air of the cocoonery.

Fifteenth day. On this day, the rousing of the silk worms, which they begin to manifest, is an indication of the completion of the third age.

Fig. 7.

General remarks on the third age. In six days, under ordinary circumstances, the worm passes through its third age, in which those proceeding from 5 ounces of eggs, on the same condition, have consumed 300 lbs. of leaves and young shoots. If to this be added 45 lbs. of refuse rejected by picking, 345 lbs. have been taken from the trees: i. e. at the rate of 69 lbs. to the ounce.

The muzzle of the silk worm, during the third age, has maintained a reddish ash colour; it is no longer

shining and black, as it appeared in the first ages, but now becomes more lengthened and prominent. The head and body also are much enlarged since the casting even of the skin, or before they have eaten at all; a proof that they were straitened in the skin they have cast, and being now unconfined, the natural specific density or rarefaction of their substance, has expanded them at the ordinary rate of atmospheric pressure.

At the completion of this age, the body of the silk worm is more wrinkled, they become of a yellowish white or fawn colour, and, without a glass, no hairiness is visible. In this third age, we first hear a peculiar hissing noise, when the worms are feeding, similar to that produced by the burning of green wood. This noise does not, however, proceed from the action of the jaws, but from the continual motion of the feet, sounding not unlike a soft shower of rain, until the worms fasten on their wood, when this cocoonery music ceases.

Fourth age. The worms, with proper care, surviving now from five ounces, should have a space equal to 412 square feet, and should be equally distributed as already prescribed, and the temperature should be not less than 68°, nor higher, if possible, according to Dandolo, than 71°, but whenever it rises, as, at this season, it inevitably may, higher, compensating means must be sought by the instant removal of all litter liable to fermentation, and promoting, by ventilators and other means, a due circulation of air in the cocoonery. We must again insist on the impropriety of lifting off the hurdles those silk worms that have completed their third age until nearly all are roused. The one part waiting a day, or even a day and a half for the other, is, as said before, not injurious. It is, however, advisable to place the early roused in the coolest part of the laboratory, and the late roused worms in the warmest* part; and if this

* Be it remembered that moderate increase of heat sharpens the silk worm's appetite, and consequently accelerates its growth, and vice versâ, that appetites, as well as growth, may be thus artificially retarded.

be inconvenient or impracticable, to give to the former less, and to the latter more space; and by one or the other, or by both these means, their advance towards the maturity of their fourth age, will be so preserved that they will, which is important, moult together.*

Sixteenth day. On this day give 37½ lbs. of the young shoots, and 60 lbs. of picked leaves of the *white mulberry* coarsely chopped with a large blade. To this quantity 78 lbs. of the multicaulis will be equal.

When the moment of removing the worms from the hurdles arrives, one or two hurdles only at a time should be covered with young shoots. These shoots, loaded with worms, are afterwards put on the empty shelves, and removed, as in the first moultings. Should there not be a sufficiency of small boughs, branches of 15 or 20 leaves (white mul.) tied together by the stalks, will answer the purpose. The removal should be effected by three persons: one to fill the shelves, one to carry them, and another gently to remove them from these shelves on the hurdles, in the space allotted to them.

When those which have revived are removed, others yet remain torpid on the 174 feet square of hurdles, or that have not yet strength to climb on the shoots or branches of leaves. But it will be discovered that the early roused have probably by this time eaten all the leaves on the young shoots or branches that served to carry them, and that they remain without food on the shelf. They should then be supplied with 30 lbs. of *white mulberry* leaves, chopped a little, or with 24 lbs. of those of the *multicaulis*. The other 30 lbs. of leaves should not be given until the second meal has been thoroughly consumed. At the end of this day, the worms begin to evince renewed vigour: they move more nimbly, they grow perceptibly, they lose their ugly colour,

* It will be advantageous to have marked on each shelf, its dimensions in *square feet:* or the product of its length multiplied by its breadth.

become slightly white, and assume more animal vivacity.*

Seventeenth day. 165 lbs. of the white mulberry leaf, slightly cut up, will now be wanted. The first meals should be the lightest, the last, most copious. 132 lbs. of the *multicaulis*. The worms now grow fast, and their skin continues to whiten.

Eighteenth day. 225 lbs. of the sorted leaves of the *white mulberry*, a little cut; or 180 lbs. of the leaves of the multicaulis are, at this time, the proper proportions. The former meals of the day to be the most plentiful.

Nineteenth day. Of the *white mulberry*, the cut leaves to be distributed at successive meals, should amount to 255 lbs., the first meals of the day still being the larger, in the proportion of about 5 to 3. To this quantity, 204 lbs. of *multicaulis* leaves are equal. The worms continue to become whiter, and in size, increase to 1½ inches long.

Twentieth day. Reduce to 128 lbs. of the picked leaves of the *white mulberry*, since on this day, the appetite of the larvæ diminishes; or of the multicaulis leaves, give 103 lbs. Let the first meal be the largest, and gradually lessen till the last. Several are beginning to become torpid, therefore, with discrimination, give leaves, to prevent both waste, and avoidable fermentation, only, as they are wanted. The worms are now 1¾ inches long.

Twenty-first day. Of the picked leaves of the *white mulberry*, 35 lbs., of the *multicaulis*, 28 lbs., are sufficient for the day. The changeable animals under our care are now decreasing in size, since they lose part of their substance before they sink into torpor. The greenish colour of their rings becomes changed, and their skin is now wrinkled.

* In the third age, about 300 lbs. of picked leaves (240 lbs. of multicaulis) have been put on the hurdles; and the litter, in the former case, is about 93 lbs. in weight. Consequently, 207 lbs. of leaves have been transmuted into increase of animal substance, or expended in evaporation. The fœces of the insect, during this age, would weigh about 18 lbs.

Twenty-second day. The worms rouse on this day, and thus accomplish their fourth age.

Fig. 8.

GENERAL REMARKS ON THE FOURTH AGE. In about 7 days, the worms have accomplished their fourth moulting: their old skins have gone, and they have new ones. In this period, they have consumed, of the *white mulberry* leaves, 900 lbs., from which the refuse rejected was 135 lbs. being in all 1035 lbs. of leaves drawn from the trees for 5 ounces; or at the rate of 207 lbs. per ounce. The proportions of the *multicaulis* equivalent to these quantities respectively, are 720 lbs., 828 lbs., and 166 lbs. The insects now are assuming a darker colour, or grayish, with a red tinge. It may be here remarked, that whenever cocooneries are kept in proper order, the internal air is perceived to be preferable to the external, from the agreeable odour of the *fresh* mulberry leaves.

FIFTH AGE. *General Remarks.* This age of the silk worm is the longest and most decisive. It requires some experience and practical good sense, to conduct them through to maturity. As they grow in this age, they are liable to three evils, which attack them according to their strength, and to their distribution in the cocoonery, and may inflict weakness such as to cause their destruction: these are—

1st. The quantity of fluid disengaged every day, which through this age is incredible, from the body of the insect, by transpiration and evaporation of the leaves. 2d. The mephitic exhalations, daily emitted from the excrementitious matter of the insects, and fermentations of the *remains* of the leaves, which *now* are liable, without constant removal, to accumulate daily to a large amount.* 3d. The damp as well as

* It is surprising to find how large a volume of miasma disengages itself, in the fifth age, from the silk worms. If one ounce of their fœces

hot state of the atmosphere of the cocoonery, which at this time may result from the compound cause of the heat and rarefaction of the external air and that of the exhalations, which now are greater, not only in proportion to the magnitude of the accumulation, but also to the increased temperature of the season. The combination of these adverse circumstances may inflict also injuries on our patients in three ways: 1st. The skin of the worm, by these means, is liable to relaxation, to lose its elasticity; languor, decrease of appetite, morbid secretions, and unless the causes be arrested, death may ensue. 2d. The quantity of vital principle in the air, by these means, is diminished, and, consequently, the breathing of the insect is not only impeded, and rendered more laborious, but also less effectual in every equal volume of air, and space of time, to its continued health and existence. 3d. The increased vegetable fermentation and fœcal exhalations, aggravated by the heat of this usually hot season, disturb the electrical constitution of the air, which injures animal vitality, for a cause analogous to that which turns milk sour, from the disengagement of oxygen in air by electrical action. On the effect of electrical phenomena on animal and vegetable substances, see Rozier's Cour d'Agriculture.*

be placed in a bottle of three half-pints capacity, and hermetically corked, in eight hours, the air in the bottle will be found, on experiment, to be destructive to animal life. A small bird placed therein would die in a few moments, and a lighted candle would be instantly extinguished. The cocoonery, in this age, contains 1200 lbs. of fœcal matter, sufficient to vitiate, in one day, a volume of atmospheric air equal to 1696 cubical feet. "*Dictum sapienti sat est*," though a very old adage, will hold true as long as the world stands: "*A word to a wise man is enough;*" and not one word need be said on the imperative necessity of getting rid, almost hourly, if possible, or daily at least, of this rapidly accumulating compound, causing mephitic exhalation from animal residua and fermenting or decaying vegetable matter.

* Vegetables, under the sun's rays, give out oxygen useful to animal life; but in the shade and darkness, part with carbonic acid gas noxious to the same. Into a wide-necked bottle of the capacity of 2 lbs., place one ounce of fresh mulberry leaves, which, after corking and exposing to the action of the sun for an hour or more, uncork, invert, and introduce a lighted taper: the light will become brighter and larger, evincing

Twenty-third day. At this time nearly all the worms are roused, or have accomplished their fourth moulting. The laboratory should be of the temperature of 68 or 70°; and the tenants, for they pay good rent, must be accommodated with premises equal to 917 square feet, or 183½ square feet to each ounce of eggs. In the first day of the 5th age, the worms should fill a space of about 508 feet square on the shelves, which added to the 413 feet which they occupied during the last age, and which should now be cleaned,* form together the 921 feet square on which they are gradually to spread until the termination of

the disengagement of oxygen from the vegetable. Into another similar bottle, put also an ounce of leaves, which, after corking, place in obscurity for about the same time; then introduce a bird, or a lighted taper, and the bird will perish, or the light be extinguished, demonstrating the evolution of carbonic acid gas, instead of oxygen, as in the former case, from the same volume of vegetable matter in darkness and not in light

Many have thought that light was injurious to silk worms. How long before the days of alchemy, astrology, and Canidian conundrums end! Were they made never to see the light in their native climes, or to live with owls and bats in Cimmerian caves, or to browse on Egyptian mummies, in darkened pyramids instead of mulberry leaves? On those sides of the hurdles on which the sun shone more freely, Count Dandolo found the silk worms more vigorous. He adds, "I have even seen the sun shining full on the worms, without their seeming annoyed by it. Had the rays been too hot, and shone too long on them, they might have suffered; but this need not occur, and does not affect the question; as I do not propose exposing the silk worms improperly to the sun, but only desire to show that the air is more vitiated, and that there is more damp in a dark laboratory than in a light one."

* The young shoots should be directly distributed on 5 or 6 shelves, and should the shoots fail, bunches of leaves as before directed, may be substituted. As soon as the shoots are loaded with worms, they should be taken off. If the worms of one shelf be almost all roused, they will be sufficient to fill the space of rather more than two shelves. When 508 square feet are filled, the shelves that are left empty should be cleansed. If in cleaning, any remaining worms should be found roused, by presenting some shoots or leaves, they may be taken off like the others. The sheets of paper with the litter, must be rolled up, and poured into the basket for this purpose; notwithstanding that the litter which is just removed appears to be green, and without any unpleasant smell, yet the chlorine gas from the fumigatory bottle, or the chloride of lime should be used as before directed.

In a large establishment of five ounces, at this moment, the attendance of six persons will be necessary. Two should lift and put the worms on the shelves, two carry them away, one should remove and

this state. This day about 90 lbs. of the young shoots of the *white mulberry*, or of common leaves not sorted, and also 90 lbs. of picked and sorted leaves; in all 180 lbs. which is equal to 144 lbs. of the leaves of the *multicaulis*.

The 90 lbs. of shoots and leaves on which the silk worms were removed, furnish an abundant meal; the *other* 90 *lbs. of sorted leaves should be divided into four meals, which should* be given them every three hours. In giving the first meal, care must be taken to straighten the lines of the strips on the hurdles, by sweeping any straggling leaves or worms into regular order with a little broom.

In the preceding age, 900 lbs. of leaves were distributed, and the litter of that age, weighed 300 lbs. The worms therefore derived sustenance from 600 lbs. of the substance including the loss by evaporation. The excrement weighed about 93 lbs.

Twenty-fourth day. There will be wanted on this day, of the *white mulberry*, 270 *lbs.* of leaves sorted, and divided into eight feeds. The first should be the least, of about 26 lbs., and the last the most plentiful, or of about 48 lbs. Of the *multicaulis* 216 lbs. for the day: of which the first and last feeds 21 lbs., and 39 lbs. respectively: the intermediate feeds increasing by a corresponding ratio.

Twenty-fifth day. The worms will now require of the *white mulberry* 420 lbs. of sorted leaves; divided into eight meals, the first smaller increasing to the last; the intermediate feeds accordingly. Of the *multicaulis* 336 for the whole day. On this, and the preceding day, the worms continue to whiten; many are now upwards of two inches in length.

Twenty-sixth day. Our proportions, must be now, of the *white mulberry*, 540 lbs. of sorted leaves; the intermediate feedings increasing by a corresponding

place them on the hurdles, whilst the other must roll the papers and litter, clean the hurdles, and carry out the dirt; and if judged necessary, an additional person may be employed in distributing shoots to the later silk worms, that all things may proceed without bustle or confusion.

ratio, of the *multicaulis* for the whole day 432 lbs. The voracious period of the worm is now rapidly advancing. Some are now 2½ inches long.

Twenty-seventh day. Of the *white mulberry* for the whole day, 810 lbs. of picked leaves will be wanted. Of the *multicaulis*, 648 lbs. for the whole day.

If necessary the worms should now have intermediate feeds. When the regular distribution of leaves is devoured in less than an hour and a half, the worms need not receive any until the regular feeding, which it is understood is every three hours.

Twenty-eighth day. Give now of the *white mulberry*, 975 lbs. of picked leaves, divided into eight feeds, the last of which to be the most abundant. Of the *multicaulis* 780 lbs. similarly divided. The silk worms eat now most voraciously, and some even attack the fruit which is among the leaves. An intermediate meal may be added when it appears necessary, as may be inferred when the full quantity necessary to constitute a meal, is devoured within an hour. Some of the worms are now three inches long; have become whiter, and present to the feeling a velvet surface.

Twenty-ninth day. 900 lbs. of *white mulberry* well sorted leaves will be required this day; or 720 lbs. of the *multicaulis*. The first meal should be the largest, the latter diminish gradually, but should the necessity of any intermediate meals be indicated, as it would by the sign already stated, it should at this important crisis be given.

Some of the worms are now upwards of 3 inches in length: in certain cases, from extraordinary health and good attention, they are known, in this country to attain the length of even 4 inches. The extremity of the insect begins to grow shining and yellowish, their voracity to abate, which intimate their arrival at maturity: in size and weight, on an average, eleven of them will weigh 2 English ounces avoirdupois.

Thirtieth day. The diminished appetite of our cocoonery-boarders requires now only 660 lbs. of the

white mulberry leaves, well sorted; of the *multicaulis*, 528 lbs. to be given at eight meals; the subsequent feeds to be gradually lessened. Give to backward worms, if necessary, intermediate meals.

The increase of the yellow colour extending from ring to ring, the loss of the dark green colour before marking the rings, the shining of the backs, their diminishing bulk, and propensity to attach themselves to the edges of the hurdles to part with redundant matter, severally indicate their advance to maturity.

Thirty-first day. Diminished wants now lessen our care to the provision of 495 lbs. only of the *white mulberry*, or of 396 lbs. of the *multicaulis;* which must now be distributed with care and discretion as wanted.

Fig. 9.

General remarks on the fourth age. Reckoning 240 lbs. of sorted leaves which are to be given to-morrow, or on the 32d day, the worms will have consumed during this fifth age, 5,490 lbs. of picked leaves. Adding to this, 510 lbs. of additional feed if required; the total weight taken from the trees will be 6,000 lbs.

The total weight of excrementitious matter drawn from the shelves in the fifth age, is about 3300 lbs. which demonstrates, that of (5490—3300) 2190 lbs. a part served to nourish the silk worms, and the rest exhaled in vapour. Calculating the weight of the leaves, and the loss by evaporation, the worms, it appear, have consumed in their fifth age alone 1200 lbs. of leaves per ounce.

Thirty-second day. During this day the fifth age will be terminated and the rising begin. Every thing should be cleaned and kept clean. The silk worm will be now perfected, which may be known by the following signs, 1. When the insects, instead of eating

leaves put on the hurdles, get on them, and rear their heads, as if in search of something else. 2. When, on looking at them horizontally, the light shines through them, and they appear of a whitish yellow transparent colour. 3. When numbers of the worms which were fastened to the inside of the edges of the hurdles, and straightened, now get on the edges, and move slowly along; instinct urging them to seek change of place. 4. When numbers of worms leave the centre of the hurdles, and try to reach the edges and crawl up upon them. 5. When their rings draw in, and their greenish colour changes to a deep golden hue. 6. When their skins become wrinkled about the neck, and their bodies have more softness to the touch than before; and feel like soft dough. 7. When on taking a silk worm in the hand, and looking through it, the whole body appears to have assumed the transparency of a ripe yellow plum. These signs are prognostics of their rising. Of course every thing, before this, should have been prepared for the accommodation of the insects, that those which are ready may not waste their strength and silk, in seeking for the support they require.

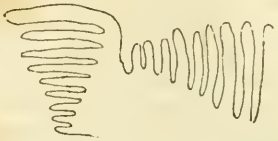
In another place, the arches, corners, angles or cabins, in which the silk worm spins, have been described as being part of the apparatus of the cocoonery. Some furnish them with oak branches, others with faggots, with straw set on end, and tied near the middle, or with other conveniences. Much depends on the taste of the cultivator; for on this point, though some methods are preferable to others, still opinions will differ, and not much difference will ensue in the cocoons when spun.*

In adopting the plan recommended under the head of cocoonery, none of these slovenly appendages are required. They are in a few minutes in their cabins, and after looking about to ascertain in what position

* The time occupied in feeding may be accelerated or retarded by the manner of feeding. Two or three hours are recommended in this book as the period between the times of feeding, and two feedings in the night. In this way they will mount a day or two and sometimes three days

they should arrange their building, for the larva is provident and has forecast, it commences to throw the floss around it. The spinning is now fairly commenced.

Fig. 10. Showing the form in which the silk worm throws about its thread.



The care hitherto commended has tended :—

1st. To preserve the silk, contained in the secretors of the silk worm, in a constantly fluid state.

2d. To keep the skin of the silk worm sufficiently dry, and constantly in the degree of contraction necessary, and without which the silk worm would perish.

3d. To prevent the air from being corrupted, and which might make the silk worm ill, or cause its suffocation, at those very periods when it most needs its highest vigour to pour out all the silk it contains.

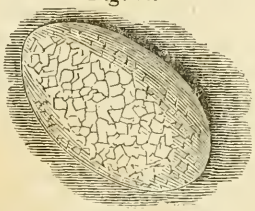
The silk worm has now mounted to spin, but some may yet linger. Proper care should be taken thoroughly to clean the shelves and hurdles; the lingering worms should be placed on a separate shelf, that all the cocoons formed in the cabins above it may be *completed* and *gathered* at the same time, which can thus be done at the earliest moment. To those removed a very small quantity of leaves should be given; but the slightest injury at this age should not be given them, being particularly hurtful. To these removed worms, instead of the usual cabins as in other cases, it is better to place in their way boughs of oak, or heads of broom corn. The lazy worms will soon be distributed among the branches and begin their work.

When the worms begin to rise the greatest care

earlier than when only fed three or four times in the 24 hours. But over feeding is injurious. The quantity requisite should be divided into proportions according to the period of the age. In coming out of the moulting or going into it, the feed should, as before remarked, be increased or diminished, the appetite of the worm sharpening or failing at such periods.

should be taken to keep the temperature equable. It should stand from 68° to 71° Fahrenheit, by means of the ventilators in the sides, roof and floors. They should also be kept as dry as possible, and all moisture from excrementitious or other causes must be carefully removed. Those that drop down while spinning must be carried to and placed with the lazy ones spoken of above. The air may be admitted freely when the cocoons have become of a proper consistency. Every diseased or dead worm, and all bad smells should also be carefully removed.

Fig. 11.



Sixth age. This age commences in the pupa state, and ends when the moth emerges from the cocoon. The following are the necessary things that remain to be done: 1st. To gather cocoons: 2d, To choose the cocoons which are to be preserved for the eggs or seed: 3d, Preservation of cocoons until the appearance of the moth: 4th, The daily loss of weight which the cocoons suffer from the time they are finished until the appearance of the moths.

Gathering the cocoons for seed. In our description of the cocoonery or *ateliere*, some account of a place was also given for the matured caterpillar to mount and spin. We have seen them cease to eat, ascend to their cabins, elaborate their cocoons, and retire from the gaze of mortals. In three or four days from the commencement of the spinning the silk worms have finished their cocoons, and in seven or eight days* they

* M. D'Homergue, says, eight days, but six days if there have been no thunder-storm, to interrupt the labours of the moth.

Dr. Pascalis informs us that with the use of electricity, his silk worms have spun in 27 days from the hatchment.

will be ready for picking from their *arches*, cabins, bushes, or corners. The gathering should be performed with care, as much waste of silk is thereby occasioned. The cocoons may be gathered in five days from being finished, but where they do not all mount on the same day it is possible that those may be culled that are not quite ripe with those that are.

In gathering they should not be bruised, but carefully taken from their arches with all their floss. The floss should then be taken off with great delicacy, the fibres not pierced, and the cocoons not flattened or bruised. They should then be SORTED ; this is best done at the time and by the person who takes off the floss. *Sorting* is selecting those intended for seed, by placing them in a separate place, always putting the imperfect, soiled, or those otherwise injured by themselves. *Fourteen* ounces of selected cocoons are equal to *one ounce of eggs*, and one ounce of eggs will make 120 *lbs. weight of cocoons.* In selecting the cocoons for eggs the white are to be preferred. An equal number of the male and female cocoons should also be selected ; which may be known by the *male* cocoon being *smaller* than the female, depressed in the middle as it were with a ligature, and somewhat sharp at one or both ends, with a greater degree of hardness in those parts. The *female* cocoons are larger than the male ; are round, full, not much, and often not at all depressed in the middle, and more obtuse at each end. The moth makes its appearance in from ten to fifteen days. Some think that all balls perfectly formed are equally good—others deny this; the truth seems to be that few well constituted balls will not give well constitutioned moths and eggs.

3. *Preservation of cocoons intended for producing eggs.* Experience shows that where the temperature of the room is above 73° the transition of the chrysalis to the moth state would be too rapid, and the coupling would not be productive. If below 66° the development of the moth is tardy, which is also injurious. Damp air will change it into a weak and sickly moth.

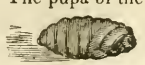
The apartment should, therefore, be kept in an even dry temperature, between 66° and 73°. When collected, spread the cocoons on a dry floor, or on tables, and strip them clean of down or floss, to prevent the feet of the moth being entangled in it when coming out; while cleaning them, all those that appear to have any defect should be laid aside. This is the time, also, to separate the male and female cocoons, as far as we can distinguish them.

4. *The daily loss in weight of cocoons of* 1000 *oz.*, from the time of formation, till the moth escapes from them, is thus tabularly stated by Count Dandolo.

	ounces.
Gathered from the cabins, fagots, &c., and cleaned, the cocoons weighed	1000
First day following, the said cocoons weighed	991
Second day	992
Third day	975
Fourth day	970
Fifth day	966
Sixth day	960
Seventh day	952
Eighth day	943
Ninth day	934
Tenth day	925

It is a loss for the purchaser of cocoons, to receive those that are of different ages, because, when in some cocoons the moth is preparing to come forth, and other cocoons are not so forward, the spinners are at a loss whether to let it come directly, or to kill the chrysalis to preserve the cocoon. If the rules which have been given, be exactly followed, this loss will be avoided, and the cocoons will be perfectly formed, and ready to be reeled off, at the end of seven days, reckoning from the day they first rose on the bushes or frames. By reeling off the cocoon between the period in which they are formed, and that in which they pierce the cocoon to make their exit, the silk is of a much better quality, and the necessity of killing the chrysalis is obviated.

Fig. 12. The pupa of the bombyx.



The Seventh age *of the Silk Worm.* This age completes the entire life of the moth.

When the *pupa*, *aurelia*, or *chrysalis*, has completed its transformation in the cocoon, and is ready to depart, it puts forth a *liquid*, some affirm an acid, to dissolve the gum; and having softened the point through which it intends to make a passage, in defiance of the maxim *vestigia nulla retrorsum*, it forces its beak through the fibres of the cocoon, and with two or three efforts, makes its exodus from its prison into open day. Sometimes the moth does not injure the cocoon from winding, but generally it does so, and such cocoons are therefore usually set aside for floss, to be carded and spun like cotton. Sometimes the moth gets entangled in the fibres, or the cocoon is too hard for the feeble moth, and she deposites her eggs in the cocoon, and dies there, or dies before this deposit. They should always be left to their own unassisted efforts. Nature will do more for them than art, and if a few should die, that few will be less than if the operation which some resort to of cutting open a way for them were resorted to. At such times, the cocoons should be spread thin on tables; their natural mode is to put forth their heads and legs first, as they help themselves by laying hold on something with their feet and antennæ, to drag out the remainder of their body. They live, after leaving the cocoon, from five to twelve days, according to the temperature to which they are exposed. The moths do not come forth the first and second days; they are chiefly hatched the fourth, fifth, sixth, and seventh days, according to the degree of heat in which they are kept. The hours in which the moths burst the cocoons in greatest number, are the first three or four after sunrise, if the temperature be from 64° to 66°. The male moths, the very moment they come out, go eagerly in quest of the female. When they are united, they must be placed on sheets of newspapers, or some such thing, so that when soiled they may be thrown away. Much care must

be taken in raising the *united* moths. They must be held by the wings, so as not to separate them; but it is better not to remove or disturb them when coupled. It is sometimes the case that the male and female must be brought together. When a shelf or table is filled with moths in a state of union, the room should be made so dark that a person can hardly see in it. If there be more males than females, separate the unmated from them. They may be easily known, as the body of the female is nearly twice the size of the male; besides, the male keeps constantly fluttering in the light. The hour of junction should be noted, and if any disunite, they ought again to be brought together; light injures them; the fluttering weakens, and causes a loss of their vital, and consequently fecundating powers. The cocoons from which they emerged should be put away, and as soon as the moths separate, after a sufficient time for conjunction, the males should be thrown away. During this period, the attention must be minute and constant.

SEPARATION OF THE MOTHS AND LAYING OF EGGS. The male and female moths, at the proper time, if in proximity, will usually unite of their own accord; but where they do not, they should be brought by the superintendent into juxtaposition. After being coupled, they should be permitted to remain till they separate of themselves. European writers recommend that they be separated after *six hours;* but this is not consonant with the laws of nature, which are always the best guide in the instincts of insects and animals. If they separate prematurely, they ought again to be brought together. Let the place be dark. The most vigorous of the males must now be placed with the unmated females. Should the males be deficient in numbers, let the separated males be put in a dark box, and united to females having no mate. The females are not injured by waiting for the males a few hours, the only loss sustained is a few unimpregnated eggs. While they are thus united, have clean cotton calico, white or coloured; or sheets

of white printing paper ready. M. Deslongchamps says, he has used the male moth successfully for six couplings, and the male, after the sixth union, was as lively and brisk as at first; and it is said the eggs of the *thirteenth* coupling had all the characters of those of the best quality. The disunion, however, had always to be effected with the hands. Should this practice be found to answer, many cocoons may be saved for winding, which otherwise would be pierced by the male moth.

The moths having all been separated, and the males thrown away, the females are laid upon white or any light-coloured paper, calico, or linen, in such order that they may deposite their eggs. They should have space to deposite their eggs, and to remain from 36 to 40 hours untouched. If the papers or cloths are not covered, other females should be laid in the vacant spaces. The temperature should be 65° to 80°. Unimpregnated eggs will appear yellow, and remain so. Those imperfectly so, reddish, and will not produce worms. If a moth of a sulphur colour be united with one of a white, a handsome orange will be produced. The colour, says Mr. Swayne, depends chiefly upon the female. Eight or ten days after the deposition of the eggs, the jonquil colour peculiar to them will change to a reddish gray, and afterwards into pale clay hue; the form is lenticular, with a slight depression on both surfaces.

Preservation of the eggs. When the eggs have been deposited on dry cloths, and passed through their several changes of colour, as before described, the cloths or paper on which the eggs have been deposited, must be folded so as to admit air into them, to prevent them from heating. The air should be dry, not above 50°, and not below zero. Some think they should not be exposed to frost; but this is an error; they have been repeatedly so exposed down to zero, and have subsequently been hatched, and produced an abundant crop. It is, as before said, sudden changes that affect the egg. Much has

been said and written upon this subject, by men professing great experience, certainly without having made an *experiment.* If they can be kept between 32° and 55°, without injury from damp, the eggs may be regarded as perfectly sound. They must be preserved from all insects, vermin, and other enemies, as all insects, birds, and vermin greedily devour them. "Good keeping will produce good worms," said Mr. Fally, and *if properly treated, will never degenerate in this climate.*

Fig. 13. *Fig.* 14.

Stifling the Chrysalides.—Where the quantity of cocoons is small, the necessity of curing may be superseded, by immediate reeling; or if the culturist has on his premises an ice house in which to deposit the cocoons, the necessity is obviated, as the chrysalis will remain in a passive state, until brought to a temperature of from 40° to 50°. This system is advisable where practicable, since stifling by baking and other processes, is in some degree injurious. Otherwise, the moth must be destroyed, between the 4th and 12th day at furthest after the completion of the cocoon, or it will cut its way through, and thus render the reeling of its work impracticable. There are several methods of killing the pupa. 1st, *by baking* in an oven of the temperature of 88° or 89° wherein the cocoons are shut from 4 to 6 hours, after being first placed in bags which must be occasionally turned or moved to effect an equal exposure. 2d, *by the sun's rays* at a temperature of about 88°, in which they may be left for three days from 9 o'clock A.M. to 4 P.M. 3d, *by steam.* For this purpose, place the cocoons in a basket lined

with three or four folds of woollen cloth to promote the equal dispersion of the steam. Suffer the cocoons to remain in this basket, of dimensions such as to cover the mouth of the kettle, after the basket, raised on two pieces of intervening wood, has been placed over the kettle with water kept boiling over the fire. 4th, *by suffocation in the gas from charcoal*, which is effected by simply shutting the cocoons up for a night in a close room, wherein a pot of burning charcoal is placed. This last process is said to be the invention of G. B. Smith Esq., of Baltimore, and to be the least injurious.

PART IV.

REELING, THROWSTING, DYEING, AND WEAVING.

CHAPTER I.

REELING.—The word FILATURE has two meanings; it is called by some *reeling*, and by others the *place* where the reeling is performed. The operation of winding or reeling from the cocoon is called, in French, *filer*, to spin; the word *filature*, a derivative from *filer*, means, therefore, an establishment where the reeling is performed.

REELING. Before the process of reeling is described, the character of the cocoons to be selected for the filature should be understood. In another place has been mentioned the method of *sorting* the cocoons for breeding, the cocoons not thus appropriated are divided into *nine* different qualities, namely :—

1. GOOD COCOONS, or those fully brought to perfection. These are not always the largest, but are compact and free from spots.

2. POINTED COCOONS, or those having one end rising in a point, these give out their thread in reeling a short time, then break or tear at the point where the silk is weak, and can be wound no further.

3. COCALONS, or cocoons that are larger than the regular cocoons, but do not contain more silk; their texture being less compact. These in winding, must be immersed in cold water, as they furze and become tangled in the operation. They should be separated from the others and laid by themselves.

4. DUPIONS, or *double cocoons*. The threads of these are so intertwined that they frequently break in reeling, and sometimes cannot be wound at all. These are usually *one per cent.* of the whole quantity.

5. SOUFFLONS. These are very imperfect cocoons, with a loose contexture, and are often transparent. They cannot be wound.

6. PERFORATED COCOONS. Or those that have been pierced at the end, and the filament broken by the moth, they cannot therefore be reeled.

7. GOOD CHOQUETTES. Or cocoons, wherein the insects have died before perfecting the task. These when shaken do not rattle, the worms adhering to them. These are as fine, but not so

strong and brilliant as the first named. They are apt to furze and must be reeled separately.

8. Bad Choquettes. Or defective cocoons, spotted or rotten. They furnish foul bad silk, and of a blackish colour.

9. Calcined Cocoons. Or those wherein the worms, after completing their cells, are attacked by a peculiar disease, which sometimes petrifies them, and at other times reduces them to white powder. In the former case they are called *comfit* cocoons. These cocoons are of the very best quality, and in Piedmont sell for half as much more as good cocoons. They are rarely met with.

The cocoons on the mountains are considered better than those produced on the plains. They contain more of the white, but the balls are less, and the worms in proportion smaller.

The relative value of cocoons has been stated thus :—

Good cocoons	100
Perforated	33⅓
Soufflons	25
Royal cocoons for seed	250
Royal cocoons not for seed	200

Royal cocoons pierced by the moth are spun with the soufflons, &c.

Much pains have been taken by a recent writer to throw mystery about the operations of the filature, and he would make us believe that the business is impracticable without an apprenticeship of seven or ten years. There is no doubt much of the secret *lies in practice;* but among the intelligent classes of Americans who read, think, and act—who have well constructed minds and ready hands, to acquire this art will neither require *seven years*, nor, we had almost said, *seven weeks*. It is an operation of every day's performance, and the person who devotes himself to the work will soon know his business correctly if he possess good sense.

Before explaining the operations of the filature, an explanation of the *Piedmontese reel*, certainly the best known to us, notwithstanding all the improvements* that have been made to it by various mechanics throughout our country, may be proper.

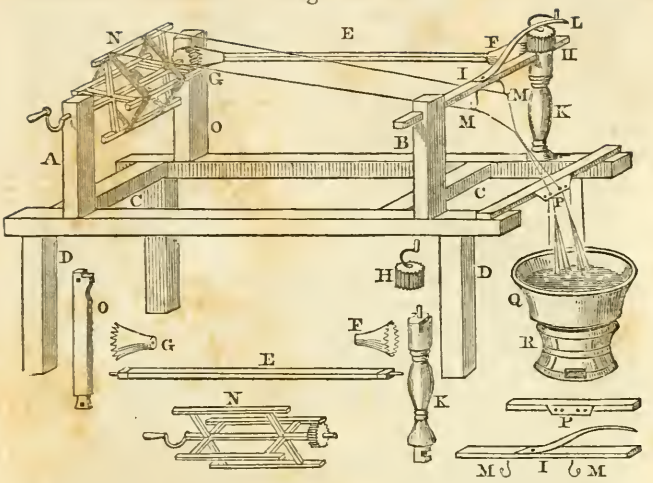
The Silk Reel of Piedmont.

The frame is 6 feet 5 inches long, 4½ by 3 inches thick. Distance of the upright posts A, B, 4 feet 4½ inches.

C C. Length of the braces of the frame, 20 inches in the clear. D D, legs of the frame, 2 feet 3½ inches long. E, shaft with a crown wheel at each end. The wheel F, 9 inches and $\frac{1}{10}$ in circumference, has 22 teeth. The wheel G, 10 inches and $\frac{2}{10}$ in circumference, has 25 teeth. This shaft has an iron pin at each

* The *improvements* heretofore made on the Piedmontese reel in this country, puts us in mind of the account presented by an Irish farrier to a nobleman for whose horse he had prescribed. One item was, "to curing your honour's horse that died."

Fig. 15.



end, 1 inch long. The pin at the end G plays in a hole in the shoulder near the top of the post O, so as to enable the teeth of the wheel to catch and work in those of the pinion at the end of the axle of the reel, which axle, by means of a pin at the end, also plays in a hole in the post O. The pin at the other end of the shaft, plays in a hole of the post K, and the teeth of the wheel F work in the pinion H, fixed on the top of the post K by means of a burr screwed on the pin projecting from the post, and passing through the centre of the pinion. This pinion has 35 teeth.* On the top of the pinion H is a crank, having a *sweep* of 4 inches, and receives, on its top, the end of the iron (it should be brass) wire carrier of the traversing bar I. The crank is fixed half an inch from the commencement of the grooves of the pinion. This crank is shown in the figure H. I, a traversing bar, 2 feet 10 inches long, $\frac{5}{8}$ of an inch wide, $\frac{3}{4}$ of an inch thick, and playing through the posts B, K; height of the post from the frame 17 inches.

L, a brass carrier of wire, No. 1, 18 inches long, fixed to the bar I, to work free by a screw. The other end is fixed by a burr, to the pin passing through the centre of the pinion H.

M M. Two wire hooks or eyes, (rampins,) $7\frac{3}{4}$ inches apart, at equal distances from the ends of the traversing bar, through

* In all the works published in this country which we have seen, the word here put *teeth* is erroneously called *feet*. We are indebted to M. d'Homergue for this correction, though his own book contains the error.

which they pass. The wires to the commencement of the turns of the hooks, are 5 inches in length.

N, the reel arms, 2 feet 2 inches and $\frac{1}{10}$ long in the clear; $1\frac{1}{2}$ inches wide, and $\frac{8}{10}$ of an inch thick; rails $20\frac{3}{4}$ inches long, 2 inches broad, $\frac{3}{16}$ of an inch thick; two of the arms are jointed, to allow the skeins of silk to be taken off, when reeled and quite dry. There ought to be an extra reel to put in the place of the one taken off, to prevent the work stopping.

O, upright support for the axle of the reel, on the ends of which the pinion is fixed, to work with the wheel G at the end of the shaft E. The pinion of the axle has 22 teeth. P, a brass plate with 4 holes 20 inches (not 12 inches as quoted by various authorities) in the clear, slightly hollowed, projecting $3\frac{1}{2}$ inches from the bar; the piece thus projecting $3\frac{1}{2}$ inches from the bar, contains four holes, so arrranged that from the centre of the one to the centre of the other is $\frac{3}{4}$ of an inch, but the four to be in the exact centre, that is, equidistant from each end of the bar. Distance from the two inside and nearest holes 4 inches and $\frac{2}{10}$.

Q, the copper basin to contain hot water, in which the cocoons are immersed when reeling off. It is 18 inches long, 1 foot bread and $4\frac{1}{2}$ inches deep.

R, the furnace to contain charcoal and keep the water hot.

Distance from the centre of the posts A, B, and O, K, $36\frac{1}{2}$ inches. Circumference of the reel or aspel $6\frac{1}{10}$ feet. Distance from the top of one arm, where it enters the rail, to another arm, $18\frac{1}{2}$ inches.

From the axle of the aspel and the traversing bar I, $4\frac{8}{12}$ feet. The law of Piedmont says 3 feet 4 inches and $\frac{3}{5}$ the American measure—that is from the guide wires and the centre of the reel. Seven rotations of the reel causes the traversing bar to move five times from side to side.

The foregoing is a description of the most approved reel now known in Europe or America. The description and cut will enable any respectable mechanic to construct one in all its parts. It is said that this reel has recently been very much improved by M. Gensoul, a French engineer, but in what these improvements consists is not known in this country.

The reeling should be performed in dry weather, and women are preferred to men, having smoother fingers, the fibres being often broken by the rough hands of men. The air should be calm; the building lofty, open on one side and exposed to the sun and air, but sheltered from the winds. A chimney or flue should conduct the steam from the place of operation, and the building should be so wide that when the winders are arranged on each side the manager should have a central passage to enable him to overlook the work. It is supposed that the floss has been stripped from all the cocoons intended to be reeled, and that the *imperfect* cocoons have been carefully separated from them.

When the apparatus is ready, the softest water must be chosen

for soaking the cocoons. Experience must in general regulate the temperature; but until that is obtained, we shall lend our assistance. Some silk requires more, others less heat, some require water from 168° to 190°; others from 190° to 202°. Some point between these should be chosen, and here a good thermometer is almost indispensable until the superintendent has, by frequently feeling the water, become familiar with the degrees of temperature, which he will by attention soon do. The temperature should never reach the boiling point, or 212°.

The good white and yellow cocoons are most easily wound. Cocalons call for the greatest care and skill; they require cooler water, and if expertly managed, they will then make silk equal to the best, but they furze out in *hot* water while winding. The dupions, choquettes, and steamed or baked cocoons in stifling, if kept a long time, require the hottest water. The dupions require soaking for five or six minutes before being reeled. The unsteamed or unbaked cocoons give off their fibres very freely, and require a lower temperature in the copper. The fire under the copper, should be increased or diminished according to the description of cocoons to be reeled, the characteristics of which are stated above.

The intention of the hot water is to soften the gummy substance they contain, and thereby facilitate the winding of the filaments. The person having the management of the reeling should be prepared with a whisk of broom-corn, or of birch twigs, cut sharp at the points; and being seated on the opposite side of the basin from the reel and facing it, the water being of the requisite temperature, and the basin on a charcoal furnace, he must throw into the basin a handful or two of cocoons of one sort and quality. They should then be pressed gently under the water for *two* or *three minutes*, in order to soften the gum and loosen the filaments. He should then stir the cocoons with the whisk, lightly and gently, *just touching them*, until one of the fibres adhere to it, when, disengaging it and laying down the whisk, he must draw the filament towards him until it discharges itself freely from the floss or coarse silk which adheres to the cocoon, and the fine silk appears. The thread is then broken; the loose floss collected and laid carefully away; the whisk is resumed, repeating the process, in each instance laying the collected fibres separately on some frame of wood near the furnace for that purpose, or on the edge of the copper in which are the cocoons, until so many fibres have been collected as are designed to make a strand of fibres. These are placed together and drawn through the outer or inner of the holes in the brass plate, resting horizontally over the copper. The same process is repeated until another strand is collected and also carried through the corresponding *inner* or *outer* hole in the brass plate. The preparatory operations are called the *battue*. If the strands are coarse they are carried through the inner and nearer holes; if fine, through

the most distant and outer holes. After being thus passed through these holes, they must be crossed or put round one another, in the manner in which a rope of two strands is twisted, for about 20 to 25 times, before being carried through the rampins or guide hooks M M of the traversing bar I, which should be made of brass or copper wire, as iron oxidizes and becomes in a short time rough. They are then carried forward and fastened to one of the arms of the aspel or reel N. The *distance* between the rampins on the traversing bar, is that which must regulate the distance of the threads on the reel; it being understood that two hanks are reeled at the same time. The filaments should not be allowed to cross until brought together at the holes in the brass plate P. In reeling, if the silk filaments come off in burrs or knobs, the water is too hot, and should be immediately cooled by stopping the draught of the furnace.

In commencing the operation, one person should turn the reel, and another attend the copper. The winding should begin slowly with a regular motion, until the threads run freely and easily. Should some of the threads prove false, as they sometimes will, a new one must be added to complete the number intended for the strand or thread. The new end required to be added is always thrown into the centre and is drawn up with the rest. A few additional cocoons should always be in the copper, with their ends ready to supply any that may run out, thereby keeping the strand uniform in size, which is one of the perfections of reeling. The crossing of the threads forming the two strands thrown on the aspel during the operation, is intended to give them a proper roundness. It aids in drying the threads, causes floating fibres to adhere, prevents the injurious gluing of the threads on the aspel, and by its rotary friction removes their inequalities and roughness, and thus causes a perfect adhesion of the fibres, insures their strength, uniform thickness, and cylindrical form; without it they would be flat. Fine silk may be crossed 18 or 20 times; coarse 20 to 25 times. A law of Piedmont regulating this procedure, appoints officers to inspect the filatures in order to preserve the character of their raw silk.

We have now the reel in motion; the operation, slow at first, increases in speed if the balls give out freely; but if they leap up towards the brass plate P, the speed must be slackened, and the spinner, who attends the balls, directs the motion. He then strikes his hand down the fibre, and places the ball again in the water, and increases somewhat the temperature of the water in the copper. The speed must now be increased or diminished, the motion always regular and equable. If the cocoons become blurry or in knots, the speed should be accelerated to the quickest motion, without endangering the breaking of the threads, or preventing the spinner from supplying the strand with fresh fibres to keep it even as the old ones run out.

The quicker the motion of the reel, the better the cocoons wind

off, and the better the ends join to the thread. The fibres, when given off freely, are less likely to break by a quick than by a slow motion. The threads do not intermix on the reel, they are distributed in such manner, that each thread ranges within a certain limit upon the asple, and no two threads lie upon the same track, the traversing bar distributing them so regularly, that it requires as some say 400, and others even 800 revolutions of the reel, before a thread lies upon the same exact course of any previous one. The intention of this is to prevent the strands from lying together, lest the gum should prevent their being unwound, and also to enable them to dry on the reel, so that an equal degree of tension may be preserved. When the skeins are finished, another asple should replace the one just used, so that while the first one is set aside to dry, the second may be in operation. It is clear then that the spinner must be always replacing and having in readiness fresh cocoons, while the reel is in motion, so that no delay may be occasioned in the process. The operation is uniform, and constant attention and repetition will enable any person to acquire experience in a few days, if not hours. The size of the strand of filaments is regulated by the purpose for which such silk is intended. They vary from *five* to *twenty* or more fibres, according to circumstances. There should be no more cocoons thrown into the copper than is intended to be wound, as by being too much soaked in the hot water, they are apt to wind off in blurrs. The cocoons should be equally soaked, and when thrown in, kept under, as they are apt to swim until saturated with the water." In joining a new end to the strand, it may be necessary sometimes to place it along with one in the winding, by rubbing them with the fingers, or gently pressing them. The art of uniting threads is acquired only by practice. The difficulty of keeping the threads even is great. The filament of each ball, is not of equal tenuity throughout, and the skill of the reeler is therefore required, so to arrange and bring them together, that the same thickness may be continuously preserved throughout the skein. This perfect equality is so difficult of attainment, that the degree of substance in the silk is never exactly defined; and with the exception of threads of two cocoons so called, silks are not distinguished as those produced from three, four, or five fibres, are said to be of three to four, four to five, or five to six cocoons. Coarser skeins are not even so nicely defined; but are called from twelve to fifteen, from fifteen to twenty cocoons, and so on. In beginning a thread of ten cocoons, from sixteen to twenty will sometimes be required to preserve the uniform thread, after a portion of the first layer has been unwound.

The quantity of silk reeled in a given time depends on the quickness of the spinner in supplying fibres to the thread from fresh cocoons. The spinner should have at her side a bowl of cold water, and also some chips or shavings, with which to regulate the temperature of the water in the copper. The cold

water is also necessary to cool her fingers in when too much heated. The facility of reeling depends much on a right temperature of the water. If *too hot*, the thread is technically *dead*, if too cold, the ends will not join well, and the silk will be harsh. The winding cannot be performed in cold water, as the fibres easily break, and with the least moisture, the filaments of the strand or thread separate, which is not the case when hot water is used.

In some of the French filatures, particularly at Cevennes, the following plan is adopted in reeling. "In preparing fine silk, the cocoons are not wound off entirely, so as to leave the pellicle of the chrysalis bare, for two reasons: first, because the additional fibre required to be added, when the first and strong part of the fibre is observed to be spent, might make the compound thread too stout, and thus cause a waste of silk; secondly, because the fibre of a cocoon which has been entirely wound off, besides being weak, also abounds in knots, which would cause it to break in winding, and injure its uniformity, in which the goodness of the thread mainly consists. Therefore, in winding fine silk, when the cocoon has given off three-fourths and a half of silk, that is, about 325 yards, it must be replaced by another cocoon; the remainder of the first cocoons must be set aside, and their silk added to that of an inferior quality. When the first parcel of cocoons is nearly finished, take out, with the ladle, all those on which some silk has been left; let them be opened, the chrysalides taken out, and the shells put in a basket with the floss first pulled off. Those cocoons which are partly wound off must on no account be permitted to remain in the basin; for they will obscure and thicken the water, and injure the colour and lustre of the silk, which can then be used only for dark colours; besides this, the consistency of the silk is injured, and waste ensues in the winding. The shells must be immediately buried, or placed among the composts for manure. As a *general rule*, the water in the copper should be changed as often as discoloured. On commencing, the holes and rampins should be always wet, to cause the thread to run easily. The waste silk, whether the remains of cocoons, or of the floss collected in the *battue*, should be carefully put aside. "Gather up the fragments, that nothing be lost," is a good rule in this case. Carded and spun like cotton, it will compose excellent fabrics. The geering of the reel should always be complete; the mortise in which the traversing bar plays should be oiled, the cog-wheels should play in proper contact; and the *bassinatts*, or defective cocoons found in the copper, which will not wind off with the good ones, being full of knobs, must be taken out of the copper, and kept and wound by themselves. The breaking of the filaments arises from ill-formed cocoons, or the improper heat of the water. The whole thread is sometimes broken in its passage from the copper to the reel, through the stopping of loops in the layer

by knobs, or by the reel being turned by a jerking motion. They should not be knotted, but slightly twisted, which will sufficiently unite them. The value of silk is increased or diminished according to the quantity of knobs or knots with which the raw silk abounds. If the silk be *clean* when the skein is opened, it is a sign of being well reeled.

The soufflons, royal cocoons pierced, and other perforated and imperfect cocoons, which will not stand the filature, are boiled in water, the soufflons for half an hour, the perforated cocoons somewhat longer, and the royal cocoons a full hour. They then undergo a process to reduce the chrysalides, and prepare them for making *fleuret*. Boiling and heating will increase their beauty. Of *fleuret*, the royal cocoons make the best, next the perforated, and lastly the soufflon cocoons. The coarse floss and refuse of the spinning, make very inferior silk. The cocoons from which the moth has escaped, it has been shown, can be frequently reeled as well as the best.

When the spinner leaves off work for a time, the cocoons should be all raised out of the water with a ladle, till his return. The better practice, however, is to let fresh hands relieve the spinner and reeler, and keep the operation in motion throughout the day. The reeler should watch the threads and the rampins, that he may apprise the spinner when any thing is wrong, for his eyes will be sufficiently engaged about the cocoons. The reeler should be instructed to rectify any thing amiss in the thread near the reel, one hand being always unemployed. No sand should be allowed in the water, as it will cut the fibres as would a knife. The water containing it should be immediately renewed. In a large filature, a boiler might be constructed to supply the coppers or tin basins, and the latter be supplied with heat from chips, to regulate the temperature, as charcoal, unless in a fireplace, is dangerous, from the carbonic acid gas evolved in combustion. In using the whisk, and in reeling, the temperature of the water is soon ascertained, as, if too hot, the cocoons rise to the brass plates, come off in blurrs, or are drawn off by the whisk in lumps. If too cold, the whisk will not catch the ends of the fibres.

A woman at Novi, in Piedmont, says one authority, will reel *one pound* of silk in a day. Another says, with later improvements, *three pounds* in twelve hours. Neither of them have stated precisely the character of the material. One may with three fibres reel a pound, while another with nineteen or twenty may reel *three* pounds with less labour. Most of our statistics are thus indefinitely prepared. M. Nouaille says a reeler and spinner can produce *one* pound of *four* or *five cocoons*. This is to the point, and means something. All agree that careful experienced spinners will from the same material make a difference of 1½ ounce of reeled silk in from 7 to 8 lbs. of cocoons.

When the necessary quantity has been reeled to form a hank, pick off the loose fibres, then take a handful of the coarse silk, and, after washing and squeezing it, dip it lightly in cold water, and with it rub the silk on the reel, at the same time stroking it with the palm of the hand. Open the windows, turn the asple or reel with a rapid movement for eight or ten minutes to dry the silk, then lay the asple aside, and place another on the reel and proceed as before. The reeled silk with the asple should be left in a dry place where the sun does not shine. This operation adds greatly to its lustrous appearance. The Piedmontese law forbids any thing but the dry palm of the hand to be used.

To reel dupions, the water must be boiling hot. The reeler, when the machine stops for the spinner to get ready, should pick off the loose floss and lumps from the silk on the asple. The strand should contain from 18 to 20, when intended for sewing silk, or from 40 to 50 for coarse stuffs. Good choquettes have from 7 to 8 in the strand, and bad choquettes or *chiques*, as they are sometimes called, from 15 to 20 fibres in the thread or strand. The satiny cocoons do not require the water to be so hot, but regulated as the cocoons are free, or otherwise, to give off their fibres. The water in the copper should be changed often, and a few only put in at a time. Before throwsting the silk is examined and selected so that different kinds may not be in the same parcel. Where the silk is of a good quality and well reeled, this tedious and expensive process may be dispensed with. The Piedmontese government have strict laws, obviously intended to insure the quality of the silk and sustain its reputation, but actually to preserve in the hands of the wealthy a monopoly of the business, whereby the poorer cultivators are unjustly restricted from the conversion of their own produce, or to derive from their own labours the advantages of which they are capable.

Disbanding the silk from the reel. This is a simple operation, but yet judgment is requisite. The cocoons, if not well sorted in reeling, will produce different degrees of tension; and this will be somewhat the case under all circumstances. To obviate this difficulty is an important point. Some cocoons, being longer in the water than others, will contribute to this cause. They do not all give off their fibres with equal facility, and hence an inequality of tension, which, though slight, has its injurious effects. To make the disbanding perfect, the skein should remain *six* or *eight hours on the asple*, which brings any inequality of tension more uniform. By this time the threads are dried and the fibres united: an important point. Before disbanding, the several hanks should be squeezed close together, the end of the strand marked so that, when it is to be unwound, it may be easily discovered; the hanks are then tied with threads of the refuse silk, at the places where they bore on the bars, and also at the opposite end to the first tie; it may then be slided off the bars, doubled and laid by in a dry place.

THROWSTING OR TWISTING.

Before describing the process of *throwsting* or *twisting* silk, it may be necessary to explain the several changes into which raw silk passes, in preparing it for the loom. These may be classed under six heads, and we will name them in the order in which they stand as respects value and fineness. It may be proper to remark that *thrown silk* is that which has been twisted in a mill or machine called a *throwsting machine*, by placing as many filaments together of the raw silk as is intended to make the designed material. The raw silk is always assorted and thrown with reference to its fineness or adaptation to certain fabrics.

1. SINGLES; or silk of the first quality.
2. ORGANZINE; or silk of the second quality.
3. TRAM; or silk of the third quality.
4. SEWING SILK of the first and second quality.
5. CORDONNET; or twist of the first and second quality.
6. FILOSELLE; or floss, fleuret, flurt, or ferret silk.

The silk, when prepared as above, is said in England to be *throwsted*, and in French to be *moulinée* or milled. The *choquettes* or *chiques* is a thread prepared in a different way for the manufacture. The five former of the enumerated classes of silk, namely, *singles*, *organzine*, *tram*, and sewing silk and twist or cordonnet, are twisted on *le moulin à tordre*, or the throwsting mill, and the latter on the *travelle*, a machine made on the same principle, but of smaller dimensions. The floss is made by carding and spinning as cotton, and is to the finer silk what tow is to flax.

SINGLES; called *le poil*, (*Fr.*,) or hair silk, is made from the first quality of raw silk, and is throwsted single as *unwound* from the swifts. It is used for *woof*, or *shoot*, when the warp is constituted of cotton.

ORGANZINE, or *organsin* (*Fr.*) is the next in fineness, and is used for warp of stuffs made of silk.

TRAM, or *la tram*, (*Fr.*,) which means *woof*, is the third in quality, contains the greatest number of fibres, and is used when all the cloth or stuff is to be of silk.

SEWING AND TWIST SILK require the greatest abundance of labour. The former (sewings) require three times, the latter, (twist,) six times as much doubling and twisting as the former. These are the perfection of thrown silk.

THROWSTING.—In a former part of this work, the history of the introduction of the throwsting mill into England has been detailed. Since then, vast improvements have been made in throwsting mills, under the skill of able engineers, by which much of the fabrics of the French, and all that of the English looms are now prepared. Amongst the Italians, the throwsting machinery invented when the Messrs. Lombe first carried off their improvements, are unchanged. Even in France, up to a recent date, no improvements have been made in throwsting organzine, although

the most extensive manufacturers in the world, and most of that material are derived from the Italians.

Before raw silk can be used for manufactures it must take one of the three forms before described, namely, SINGLES, ORGANZINE, or TRAM.

Raw silk, in its progress towards organzine, passes through six processes.

1. The winding it from skeins, upon what are called bobbins, in the winding machines.

2. Sorting it, when so wound, into different qualities.

3. Spinning or twisting each individual thread in the mill.

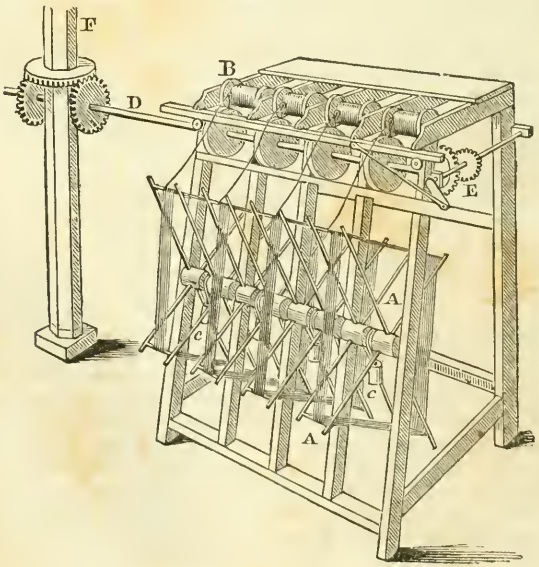
4. Bringing together upon fresh bobbins, two or more threads already spun or twisted.

5. Twisting these two or more threads together by means of the mill.

6. Sorting the skeins of twist or organzine, according to their different degrees of fineness.

The machine for winding the raw silk is called a *winding machine*, one segment of which is here given, the other parts being only reduplicates of the same, extended by the usual connections, to any indefinite length.

Fig. 16.



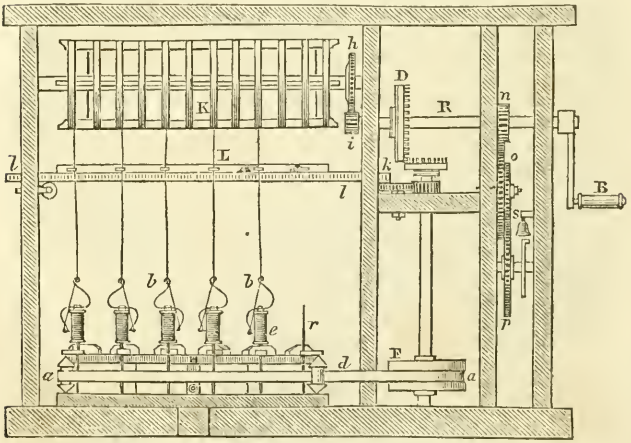
The skeins being opened they are extended upon one of the reels represented by A A, which is called a *swift*: this is formed of 4 rods passing through or fixed in the axis, so as to form a double reel of 8 spokes, 4 of them making right angles with each other, and standing opposite and parallel to 4 spokes on the other side. These parallel spokes are connected together by bands of strings, thus forming a kind of lantern wheel, and the bands can be fixed so as to vary the diameter of the wheel, in order to suit *any kind or size* of skein to be placed upon it. This provision is rendered necessary by the circumstance, that the raw silk of most countries is so wound as to be equal in circumference to a yard, according to the standard measure of the country, and as some difference exists in these standards, the reel which would suit the silk imported from one quarter, would, without some such provision, be unsuited to that of any other country.

The swifts may be made to revolve freely upon wire pivots; but as it is needful to wind the silk from them, and to deliver it upon the bobbins, with a uniform degree of tension, simple means are employed for creating the necessary amount of friction, either by means of a spring, or by hanging a looped wire upon the axis withinside the reel. To this loop a small leaden weight is attached. B B are what are called the bobbins; these are made of wood, and consist of a hollow axis, on each extremity of which is fixed a circular disc, the uses of which discs are to cause the revolution of the bobbins, in a manner which will be described, and to confine the silk upon the hollow axis. These bobbins can be easily placed in or withdrawn from the frame. D is called the layer. This is a light wooden rod having wire eyes fixed in it, one opposite to each bobbin, through which eye the end of the thread upon the reel is passed when it is attached to the bobbin. This layer has a lateral motion communicated to it, by means of a crank fixed upon the cross spindle E, which crank is turned by two bevelled wheels fixed at the end of the horizontal spindle G. The whole is put in motion by the bevelled wheel on the upright shaft F, which is connected with another bevelled wheel on the spindle G. This, revolving, carries with it the wheels or discs H H, and the discs of the bobbins resting upon these are carried round by the friction caused by their own weight, and occasion, consequently, the delivery of the silk from the reels upon the bobbins. The motion of the layers causes this delivery to be uniform over the axis of the bobbins. The constant attendance of our children upon this winding machine is requisite, in order to join the ends of any threads which may be broken in winding, and when the skeins are exhausted, to place new ones upon the swifts. When the bobbins are filled they are lifted out of the frame, and empty ones are placed in their stead, to which the skein being attached, the operation is continued. During the time occupied in removing the skeins upon the swifts, or of removing and replacing the bobbins, the process is still continued

with the unexhausted swifts and unfilled bobbins, each being in that respect independent of the other.

The third operation, that of spinning or twisting the thread thus wound upon the bobbins, is performed with the throwsting mill. The particular construction of this mill is frequently varied, but the principle of its action being always the same, it would be useless to describe more than one of its modifications. Mills of great power and considerable extent are generally used for this purpose in England, but on the continent it is by no means unusual for artisans to purchase raw silk and to employ their wives and children in preparing it for weaving. The machines which are then used are necessarily small, and are turned by hand; from the form in which it is usual for them to arrange the spindles, the apparatus is called by them the *oval*. This throwsting mill is now chosen for description in consequence of its simplicity.

Fig. 17.



The number of spindles which it contains is thirteen, and of these, to avoid confusion, only six are shown in the diagram, or cut, the remainder would be arranged behind those which are seen. Upon each of the spindles the hollow axis of a bobbin, before described, is placed, so that the bobbin has liberty to turn freely upon the spindle. Upon each spindle, just above the bobbin, a piece of hard wood is so fixed by a pin as to cause the wood to revolve with the spindle. To this wood is fixed a piece of wire called a flyer, *b*, bent in the form here given. At each extremity of the flyer an eye is formed; of these the lower eye stands opposite the middle of the bobbin, and the upper eye is

exactly over the centre, and a few inches above the top of the spindle. The thread from the bobbin is passed through both these eyes, and also through another wire eye, fixed in an oval frame L, which has a traversing motion to and fro, communicated to it by means of a crank, or an eccentric pin, K. This is fixed in a cog wheel, turned by a pinion upon the perpendicular axis E, the end of the rail *l*, being supported upon a roller, to cause its more easy and regular motion, so that the threads are guided with regularity to the reel K, in the same manner as by the layer to the bobbins in the winding machine before described. Motion is communicated from the crank B to the spindles, by means of a wheel D, connected with a pinion on the upper end of the vertical axle E, which also, at its lower end, has a drum F to receive the endless strap or band *a a*. This encompasses the oval frame G, and gives motion to all the spindles, being so confined by the rollers *d* and *a* as to press with the requisite degree of force upon the spindles, and to give all of them an uniform celerity.

It is now evident, that every revolution of the spindle and flyer must give a twist to the thread drawn from the bobbin. Whether the twist shall be hard or slack, depends upon the comparative celerity of the spindles and bobbins, and this proportion is regulated by the relative sizes of the wheel *h*, and the pinion *i*, whence the reel and bobbin receive their motion. For different manufacturing purposes, silk must be thrown or twisted with different degrees of hardness; this is provided for by the power of changing the wheel and pinion *h* and *i*, for others of different proportional diameters.

For the purpose of clearer elucidation, one of the spindles is shown without a bobbin, while the rest are all mounted, and supposed to be in action. The skeins upon the reel should be made of a uniform length, and this is attained by a train of wheels consisting of a pinion *n*, fixed on the principal spindle R, turning a wheel *o*, which has a pinion fixed to and turning with it, giving motion to a larger wheel *p*. This, again, has another smaller wheel upon its spindle, with a pin fixed in it, so that at every revolution, it raises a hammer and strikes upon a bell *s*, whereby the attendant has notice of the quantity wound on the skeins.

When the machine is employed for the first operation of twisting raw silk for organzine, which requires a strong and close twist, the wheel *h* must be of greater and the pinion *i* of less diameter than are here represented, in order that the reel K, and the bobbins, may receive a slower motion, in proportion to the speed of the spindles.

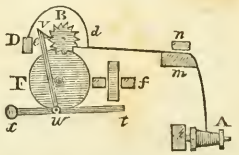
The silk is now in the form of singles, the only difference between which and the single twist in course of preparation for organzine, besides the degree of hardness noticed above, is, that in the latter process the crank must be turned in an opposite direction, so as to give a reverse motion to the machinery. Organ-

zine silk is of the nature of rope, where the combined strands are twisted in an opposite direction to that given to the separate threads, whereas, singles and tram are twisted only in one direction, similarly to twine, or to the individual strands of which the larger rope is made.

When silk is intended to be dyed in the skein, the twisting in this machine is but slight, and its direction must of course depend upon its ulterior destination, whether for tram or for organzine. Silk thread, intended for organzine, is, in this first operation, twisted in a left-hand direction.

The next operation is to bring two, three, or more of these twisted threads together upon one bobbin. The number of the threads depends, of course, upon the substance which it is intended to give to the organzine, and a careful sorting of the threads must be made, so as to bring together such only as are of an uniform texture. To effect this, a machine is used very similar to the winding machine already described. Instead of gathering the silk from the bobbins on a reel, in its first twisting in the throwing machine, when the object is to prepare organzine, it is usual to transfer it to other bobbins. In the operation of doubling, these bobbins are placed in front of the winding machine, where, of course, they take the place of the swifts, and stand two, three, or more in a row, according to the number of strands to be subsequently brought together in the organzine, in the manner shown by the following figure.

Fig. 18. Doubling Machine.



The threads in the bobbins are passed over one and beneath another wooden rail *m* and *n*, with both of which they are brought in close contact. These rails, being covered with cloth, serve to cleanse the silk in its passage, equally well with the less artificial means offered by the fingers of the person employed in winding.

In their passage or transference from one set of bobbins to the other, each thread passes through a small piece of wood *e*, which slides freely up and down in a mortised hole through the fixed board *f*. The use of these slides, which are equal in number with the threads to be brought together, will soon be seen. All the threads are then passed through the wire eye *d*, of the layer D, which it is more convenient to place behind the bobbin, causing the wire to be bent over it, as shown in the figure. The

bobbins to be filled, rest upon and take their revolving motion from the wheels F, as in the winding machine. The degree of tension given to the silk threads in winding causes them to raise the sliders *e*. Should any one of the threads break, the slider through which it passed, no longer supported by it, strikes upon the bent lever *t v*, which moving upon its centre *w*, causes the hook *v* to catch into the notches made for that purpose in the disc of the bobbin B, and this immediately stops its motion. The winding of the required number of threads thus proceeds with as much certainty as the winding of one would do. It is the business of the attendant to repair the broken thread, when the slide *e* being again raised, the weight *x*, attached to the bent lever *t v*, raises the end *t*, frees the notched bobbin from the hook *v*, and the machine is once again in motion.

The bobbins, thus filled with double or triple threads, are once more carried to the throwsting machine, and are there spun or twisted together by an operation similar to that already described, with the sole difference before mentioned, of giving a reversed direction to the spindles and flyers. In this operation, the silk, now converted to organzine, is transferred to reels instead of bobbins, and then, being made up into skeins, is sorted for sale or use. Previously to this, however, and in order to prevent its crinkling when removed, a tendency to which it has acquired in twisting, the reels are subjected for two or three minutes to the action of steam, which is found effectually and permanently to set the twist. This is a modern improvement, it having formerly been the practice to steep the reels in boiling water, a more tedious and less effectual operation. The degree of hardness given to the twist is varied according to the purpose for which it is intended; and depends, as already described, upon the relative diameters of the wheel and pinion *h* and *i*, of the throwsting machine.

The silk thus thrown is called hard silk, and must be boiled, in order to discharge the gum, which otherwise renders it harsh to the touch, and unfit to receive the dye. The silk is for about four hours in a plentiful proportion of water, into which a quantity of soap, equal to about one-third of the weight of the silk, has been placed; this assists in dissolving the gum, and in rendering the silk soft and glossy.

By this boiling, the silk, which has already in the previous operations of organzining, lost in the proportion of from five to seven and a half out of each one hundred pounds of its weight, is further diminished to twelve, and sometimes even to eleven and a half ounces, for every pound. Considerate carefulness is called for in this operation, to prevent injury to the threads from burning, which sometimes will occur, and occasion material loss to the manufacturer, or to the dyer, to whom the process is intrusted. If by reason of the viscid gum contained in the silk, the skeins adhere to the bottom of the copper in which they are

boiled, the heat is, by that means, necessarily intercepted in its passage to the water, and accumulated in the silk, which is, in consequence, partially carbonized and spoiled. Even when the injury thus occurring to the staple of the thread is less apparent, it frequently discovers itself when put into the loom, causing infinite trouble and delay to the weaver, who often, in such a case, cannot weave, in a working of twelve hours, more than, in the absence of injury to the silk, he would have woven in half that time; and the injury to him is therefore one of very serious consequence.

After this boiling, the silk is well washed in a current of clear water to discharge the soap; and when subsequently dried, although its weight is so sensibly diminished, its bulk is, on the contrary, visibly increased, and it is seen to have acquired that peculiar glossiness and softness of texture which form its principal and characteristic beauty.

The gum which has been now discharged served the useful purpose of causing the adhesion of the fibres, as originally wound from the cocoons. This end is now more effectually attained by the twist the thread has received in the throwing mill; and the gum would henceforth be considered as a foreign matter, impairing the beauty and destroying the flexibility of its texture. Were the boiling performed before the twisting, this operation would scarcely be at all completed, and at best only an entangled wooly or downy substance would be obtained, wholly unfit for manufacturing purposes. Before a thread of useful texture could be then got, the silk would require to be spun by some process similar to that followed with cotton or wool, or such indeed as is necessary with the waste silk, drawn from the cocoons in the first operation of reeling, and with those cocoons which are injured or reserved for breeding, and which it is found difficult or impossible to wind in the filature.

It has always been asserted, and, if the assertion be correct, it is a curious fact, that, notwithstanding the great advantage of superior machinery, the English throwster is unable to produce organzine silk equal in quality, and at as small an expense, or with as little waste, as that prepared in Italy. It was long held, and is still believed by many, that the Italian throwster, who is also most usually a dealer in silk, reserves the finest qualities for his own operations; and exports only that which is inferior. Supposing, however, that the difference in the value of the thrown silk is such as is stated, it is perhaps nearer to the truth to believe that the climate may influence the quality of a substance so delicate, since it is well known that, during certain states of the atmosphere, the throwing of silk is performed in England at a comparative disadvantage. Or, it may be, that the fibre of the silk is injuriously affected by its being packed before twisting, or by the lengthened voyage to which it is subjected in its transit to that country; and the higher estimation uniformly evinced by

throwsters for silk of the new crop, over that which has lain sometime in the warehouse, would seem to indicate another cause for the alleged superiority of Italian organzine. It is owing to this preference of foreign thrown silk, that, in the face of a high protecting duty, it has always met with a certain, though limited demand from the English weaver.

We find in the Congressional reports (Doc. No. 158) a notice of Messrs. Terhoven, brothers, of Philadelphia County, who have recently invented a simple and ingenious machine for winding silk from cocoons, and for doubling and twisting the thread at the same time. These operations, it is believed, have never before been united in the same machine. It answers the object intended perfectly. A fringe weaver, who has seen the silk thread finished on this machine, pronounced it equal to any imported. The inventors have received a medal worth twenty dollars from Scotland for this invention.

An improved engine for tramming silk, by U. V. Spenton of Winchester, (Eng.,) as taken from the London transactions of the Society of Arts, vol. 41, page 169, 1823; for which a silver medal was granted, and one of which machines is now in the office of the Secretary of the Treasury at Washington, is thus described.

The delivering bobbins (varying from two to four, according to the thickness of the component thread) are placed upon as many vertical spindles, the vertical position allowing the threads to quit the bobbins without any motion or revolution of the bobbins themselves. Some way above the bobbins, the threads pass singly between two horizontal slips of cloth or felt, which by their friction, give, at the same time, a certain degree of tension to the threads, and clear them from any dust or other light matter. Each thread then passes through the eye of its own drop-wire, whence they all converge and unite in the eye of the guider, from which the compound thread is distributed on the surface of the receiving-bobbin as it revolves. Each drop-wire consists of a piece of wire turned up, so as to form a right angle, of which the vertical leg is about two inches long, and is terminated by an eye through which the thread passes; and the horizontal leg is about four inches long, terminating likewise in an eye, through which passes a pin, connecting all the four drop-wires, and forming a pivot, on which each is capable of moving freely. Each thread, in passing through the eye of its drop-wire, slips down a little, and, being in a state of moderate tension, supports it at the elevation of half an inch or more above the position to which it would otherwise descend. When, therefore, a thread breaks, its drop-wire immediately falls and strikes on the edge of a wire frame, moving on a horizontal pivot, and so adjusted that the weight of the drop-wire immediately inclines downwards that side which it touches, and consequently raises the opposite side. To this opposite side a tail of wire is attached, which,

when raised, catches on a kind of racket-wheel, fixed on the same spindle as the receiving bobbin, and consequently stops it. The broken thread being repaired, is again passed through the eye of the drop-wire, and supports it above the frame; the opposite ends of the frame then become preponderant; the tail, or stop, descends out of the way of the racket-wheel, and the revolution of the receiving bobbin immediately recommences.

This apparatus is very simple and efficacious, but is liable to two inconveniences: first, that the thread usually breaks close to the pieces of cloth by which it is compressed, and some trouble and loss of time are occasioned in drawing the threads out previous to tying it: secondly, that, when a smaller number of threads than four are trammed, the vacant drop-wires must be removed, otherwise their unsupported weight would, as above described, throw up the stop, and prevent the revolution of the receiving bobbins.

The specimen of this loom, as above mentioned, being deposited, we presume, for public inspection, and to afford drawings and models, renders it unnecessary to give here any illustration by cuts or diagrams, none such being sufficient to fully meet the practical operator, and to such only could it be useful.

CHAPTER II.

DYEING.

[*In the following pages* upon dyeing, &c., *every* WORD is left out whose omission would not render the sense obscure.]

TO CLEANSE AND UNGUM SILK.—This operation consists in depriving silk of the principles which affect its whiteness. When the silk is made up into hanks, as is elsewhere described, dissolve 15lbs. soap for 100 lbs. silk. Cut the soap in small pieces to promote its solution. Fill a kettle with pure fresh water, free from calcareous impregnation, and in proper quantities. The proportions are, 7 or 8 lbs. water to 1 lb. silk; $\frac{1}{7}$ or $\frac{1}{8}$ is sufficient for most colours. For yellow unbleached silks add 50 or 60 per cent., for unbleached white silks 25 per cent., of soap. Close the furnace door, with a few live coals in it, to keep the bath hot, but *not boiling* in no case, as it would injure the lustre of its texture. Put the hanks of silk into this bath, hanging on sticks or pegs, and changing them till they are ungummed, as may be seen by the flexibility of the silk when deprived of its gum. This silk is to be wrung upon pins, to remove the soap, dressed and shaken upon pins and the hands, run a cord through the hanks,

8 or 10 on a line. Place these hanks in a bag closed at both ends and open in side. When in, sew up the side, each bag with about 30 lbs. silk. These bags must now be boiled ¼ of an hour, in fresh soap and water, checking it when boiling over with cold water, and stirring the bags to keep them from burning. The silk thus operated upon is intended to remain *white*.

White Silk, *or boiling silk to be dyed white*.—There are five parts or shades of white silk, called in China, *Indian white*, *Paste white*, *Milky white*, *Silver white*, and *Blue Azure white*. These are distinguishable by the eye, the three first are *boiled and ungummed*, as above; to the two latter azure blue is added in the ungumming. This azure blue is thus made; wash 5 oz. indigo thrice in moderately hot water, pound it in a mortar, and pour boiling water over it. Leave it to settle; when it subsides decant the clear liquid carefully for use. This, by dyers, is termed *azure*.

The silk is now prepared, as in the last instance, for white. When to be dyed:—

In a large kettle filled with clear water, of 30 buckets, put 1½ lbs. of soap; boil when the soap is dissolved, put the silk in the kettle over rods, passing through it and resting on its brim. For China white add a little annotto to the baths for a reddish tint. The silk should be turned on the rods, the end being in the liquor, and every part an equal time in the watery solution. For Indian white add a little azure; also for the other whites add azure, in proportion as the shades require. Four or five dippings will complete the work. The silk is to be wrung upon pegs, suspended to dry, and fumigated if required.

Sulphuring.—The silk in this operation should be extended on poles 7 or 8 feet from the floor, in a high apartment. For every 100 lbs. of silk 1½ or 2 lbs. of roll brimstone is used. It is put into an earthen pan, covered at bottom with a layer of ashes. The rolls, coarsely pounded, are to be placed on the ashes and lighted. The apartment is then well closed, the chimney, if there be one, well stopped, and the brimstone left burning during the night. The next day ventilate the room, and with the doors and windows open dry the silk. In winter a dish of charcoal to dry the silk should be used, the room being closed.

To boil silks which are to be dyed.—For common colours put 20 lbs. of soap to 100 lbs. silk, and proceed as before, except hat as the silk is not to be ungummed the boiling may continue 3½ hours, filling up from time to time with water. When the dye is to be *blue*, or *green*, yellow, or other colours, 30 lbs. of soap per 100 lbs. of silk are necessary, and the boiling, as before, to be in 4 hours, and then taken out. The bag, being taken out, is laid on a frame, and ripped, the silk taken therefrom; if the liquid has not sufficiently penetrated, known by slimy appearances, it should be again put in, and boiled some hours. The silk loses ¼ in boiling.

Aluming.—After washing and beetling the silk, to divest it of the soap, a line is put through them as when put to boil. They

are then put into the alum, taking care that each hank is properly exposed to the alum water, and kept well under. They must remain there 8 or 9 hours, from night till morning, then washed and wrung with the hand over the vessel, and washed in a river or other bath of clear water, and beetled when necessary. A cask of 40 or 50 bucketsful should have 40 lbs. of alum, first dissolved in hot water, and poured in and well stirred to mix it. Put into this 150 lbs. silk. If it be too weak add 25 lbs. more alum dissolved with the same precautions. The alum is increased, and more silk is added until the bath begins to smell bad. Steep the silks intended for dark colours and draw off; then clean the bath for a new operation. This aluming is the "soul of dyeing." If the alum contains iron, which may be known by dissolving a few drops of the solution of the prussiate of potash, when a blue precipitate will take place, then dissolve the alum for 10 or 15 days, in shallow vessels in the air, when the iron becoming oxidated, it will separate in the form of rust. Filter the solution, evaporate the water and recrystallize it.

The indigo blue tub.—For 8 lbs. of indigo take 6 lbs. of the best potash, and for each pound of potash 3 to 4 ounces of madder and 8 lbs. of bran, watered several times to take off its flour, and when washed well pressed to take off the water. Set it by itself on the tub bottom; boil the potash a quarter of an hour, in a kettle two-thirds full. Then leave it to settle and put out the fire. Two or three days previously to this 8 lbs. of indigo should have been steeped in a bucket of hot water; in this it should be carefully washed, changing the water, which assumes a reddish colour. This is the bath usually made by silk dyers. Put into this dye the silk or stuff, the shades of which are to be deepest. The colour will be deeper the longer it remains, until the liquor becomes weak. The tub for the above quantity of indigo must be 5 feet deep and 2½ in diameter at the mouth, and 1½ foot at the base.

Crimson.—Silks to be dyed in crimson with cochineal, should be boiled in 20 lbs. soap to 100 lbs. of silk. Wash and beetle the silk at a stream, to take out the soap; put it in an alum solution in its full strength, from night till morning, (7 or 8 hours.) Wash the silks and twice beetle them at a stream. A previously prepared bath or trough filled with river water, about ½ or ⅔, and when boiling add some powdered nut galls; boil on for a little while; then add 4 drachms to 2 ounces of the nut galls to every pound of silk. If the galls are finely powdered and sifted they may be put in with the cochineal. The silk is then washed, beetled, and spread upon sticks by hanks, thick, because crimson colour is not subject to be unequally set. The cochineal, pounded and sifted, is now thrown into the bath, and well stirred, and must have 5 or 6 boils. From 2 to 3 ounces to each pound of silk is put in according to the shade. The proportion of cochineal is 2½ ounces, never more than 3 ounces. These ingredients

are put into a *pure tin* vessel, (not into copper or brass tinned.) The cochineal and galls are boiled, put into a bath, and for every 1 lb. cochineal, 1 oz. of a solution of tin in *aqua regia*, called *composition*, is used. This composition is made with 1 lb. sp. nitre, 2 oz. sal ammoniac, and 6 oz. of grain tin. The two latter are placed in a sand stone pot, upon which pour 12 oz. water, and then add the sp. nitre. One ounce of this composition to 1 lb. of silk is used. The galls and cochineal being boiled, the kettle is left to cool. The silk is put into the tub to be steeped from 5 to 7 times. After this the bath must boil 2 hours, steeping the silks towards the end of this time. Now withdraw the fire, and wholly immerse the silks, leaving them to remain from 6 to 8 hours. The silk is now to be washed and to get two beetlings, and be wrung and dried. Chaptal says, by giving silk a ground of yellow, before dyeing as above, a poppy or flame colour may be obtained as handsome and more economical than that produced from the carthamus or bastard saffron.

Green. This colour, composed of yellow and blue, is difficult to give to silk, because, in place of applying the yellow upon the blue, we give the blue upon the yellow.

The silk, which is boiled as for common colours, must be well alumed; then cooled in a stream; the silk is then distributed in little hanks of 4 or 5 ounces, to make the dye uniform. Weld,* the *Reseda Luteola*, is to be boiled as for the *yellow*, and a bath of it prepared with clear water, so strong as to give a good ground of yellow colour. Dip the silk in this bath with great care, so that the colour shall be equal, and a perceptible green. When the ground (colour) is nearly at its height, some shreds of silks should be dipped, in order to see whether the colours have a fulness of ground. If enough, and the decoction of *weld*, and make a new trial. When the colour takes, wring the silk, cool in a stream, and beetle. The silk is then to be dressed, reformed into hanks for the tub, steeped, hank by hank, in a cold blue vat, and finally wrung and dried with care and speed. The 15 or 16 clearest shades of this kind of green need only be steeped in the tub in order to be entirely completed.

For deeper greens, or to vary the shades, add to the weld a decoction of logwood, or of old fustic, or of annotto. A little copperas is added to produce very deep greens. The apple and sea-green require a light yellow.

Lilac, a very light and brilliant tint of the violet, or of the purple, should receive the blue with caution, and sparingly. If the baths are too strong, mix fresh water with some potash in clear, cold water, to prepare a bath for blueing and greening the lilacs at will. When the bath is prepared, stir it up. Then it

* The weld plant should be cultivated by our farmers: no crop will pay better.

assumes a green colour, which imperceptibly diminishes. When the bath begins to lose its first green colour, and appear like indigo, put in the silk. The potash gives the red more of a violet tint.

Violet with Logwood. Take dyed silks, alumed and washed in the usual way; boil logwood chips in water. It will give blue, if made cold. When the logwood is warm, the colour is spotted, unequal, and less beautiful. This decoction will not last more than three weeks or a month.

If the alumed silk be steeped in a bath of Brazil wood, it may be dyed with the usual heat: after this, a decoction of logwood may be added, and the silk immersed; in this case, the bath may be warm, which it must not be if the silk had not first been steeped in the first decoction. The potash is sometimes substituted with a bath of alum in clear water, for the alteration of the tint—always when the silks are too much charged with the dye, by being too long in the bath.

Violet with Brazil wood and Archil. After boiling and impregnating the silk with the alum water, put it into a vat, more or less clear, of Brazil wood, according to the shade intended to be given. When taken out, the silk is beetled in a stream of clear water, then put into the bath of archil to complete the colour; is washed a second time, and beetled. It is then put into the tub, wrung, dried quickly, as in the case of greens and blues.

Yellow. Alum, 3 oz. to 1 lb. of silk; sugar of lead, 1 oz. to 1 lb. of alum; fustic, 1 lb. to 1 of silk; water, 2 gallons, as the shade may require. Immerse the silk over night in a solution of alum and sugar of lead; wring and dye it in the fustic. Chaptal says, that silk intended for yellow colour is boiled with 22 lbs. 1 oz. 1 dr. of soap to 110 lbs. 5 oz. 10 drs. of silk; it is afterwards washed, alumed, and put on the rods.

The yellow bath is prepared by boiling 2 lbs. 3 oz. 5 drs. of weld to the pound of silk, ½ of an hour. Strain this decoction through a sieve; cool till the hand can be kept in it, then immerse the silk. This process is repeated, and more silk immersed, till the strength of the dye is exhausted.

To extract all the virtues of the weld, and impart a golden hue to the yellow produced by it, 1 lb. 1 oz. 1 drs. potash to 22 lbs. 1 oz. 2 drs. silk are put in the vat. The second bath of weld is poured boiling hot on these, and well stirred to hasten the solution. When the bath becomes clear, decant a part of it to the first bath, and again immerse the silk. A golden hue may be imparted to the yellow by means of annotto.

Yellow on silk in hanks. Silk to be dyed, is boiled in the proportion of 20 lbs. soap to 100 lbs. silk. When boiled, it is put into the alum water and again washed, (called refreshed,) and dressed, then placed upon rods, in hanks of 7 or 8 ounces each, and steeped in the yellow bath.

For dyeing clear yellow, (*jaune franc*,) or yellow in grain, weld only is commonly used.

Put into a kettle 2 lbs. weld to 1 lb. of silk. Boil ¼ hour, the weld on blocks of wood, to mix well with the water; strain; cool till the hand can bear it; put in the silk; work it well till the colour is uniform. Keep the barque full, and the added water of a proper temperature; (all long troughs should be kept full;) the silk is now immersed: while this goes on, weld is boiled a second time in new water. Take out the silk; empty the trough one-half; fill it up again with the new decoction, in quantity equal to what was abstracted; stir up the bath, to mix the liquid; this is kept hotter than the first, but moderate, lest part of the colour taken by the silk should be destroyed. Steep in this new bath the silk: during which, dissolve potash in proportion of 1 lb. to 20 of silk. Put the potash into a small kettle, pour into it some of the 2d weld liquor, boiling hot, stirring up the potash. When this has settled, and is clear, lift out, a 2d time, the silks; put them on the frames; throw into the bath two or three ladlesful of the clear potash water. Stir well, dip the silks again, and wash anew. After seven or eight washes, examine to see if the colour be a proper one. If not, add to the bath a little potash; and proceed as before, till the colour is of the desired shade.

To make a yellow, approaching to that of a jonquille, with the potash, put into the bath a little annotto.

Poppy. The poppy colour is procured by precipitating the red of bastard saffron held in solution by potash. With this view, when silks are washed, drained, and put on the rods, lime juice is poured into the bath till it acquire a cherry colour. It is then stirred, and well worked, until it has acquired a sufficient colour.

To produce a lively, full poppy, the silk is wrung on coming out of the first bath, which it exhausts, and is then put into the second. Five or six baths are requisite to impart to it a flame colour. The poppy colour is heightened by putting the silk through tepid water, acidulated with lime juice. A ground of annotto, 3 or 4 shades paler than aurora, is requisite for silks, before exposing them to the colouring principle of the *carthamus* plant.

Black. Chaptal's directions to dye raw silk (*soie crue*) which has been reeled off dry.

The silk being cleansed, is to be bleached, by being sulphured or charged with sulphureous acid; then washed and passed water saturated with a little soap; then take ¾ the weight of silk of gall nuts; make a strong decoction of them; boil the silk therein for a short time; let it remain in the vat 36 hours; wash and wring it. The silk is so saturated with tannin, that 100 lbs. of silk thus galled will weigh 135 lbs. Put in this bath, sulphate of iron and gum, according to the quantity to be dyed; heat it; dip the silk therein, and when deeply black, put it in a

trough of cold water; turn it on a roller, that all parts may be equally exposed; then pass it through cold soap suds. Dyers have a tub on purpose for black, and when the dyeing composition is exhausted, they renew by a refresher, (brevet.) When the deposit is considerable, it is taken out, and iron filings added to the liquid. The dyeing of the silk is finished by heating the cauldron containing the dye, occasionally stirring it, to prevent the sediment from heating too much.

The liquor must not boil: add more or less gum and iron solution. When the gum is dissolved, and the liquid nearly boils, it is left for one hour, the silk, divided into three portions, is then immersed successively. The silk is slightly wrung, and aired three times. The great point is, to press out the liquor with which the silk is impregnated, and when to fill it again therewith; but above all, to air it well, as that deepens the colour. After the three wringings, the vat is to be heated, and more gum and copperas added. The reheating the vat is called giving *a fire*. Two fires are commonly given for a light black, and three for a deep dye. Sometimes the silk is left in the vat, after the last fire, for 12 hours. Commonly 30 kilogrammes (66 lbs. 3 oz. 6 drs.) of silk are dyed in one operation. This is technically called *a heat*. One fire only is required for half the quantity. When the dyeing is finished, the silk is rinsed on the rods *sec. art.*

When the silk is dyed, it must be softened, by immersing it for a quarter of an hour in soap and water, in the proportion of from 2 to 3 lbs. of soap to 100 lbs. of silk, and then dried.

Chaptal says, a full, clear, permanent black may be obtained by using a solution of iron immediately after a strong galling. The stuff is immersed in a decoction of logwood, and next into this decoction, conjoined with a solution of iron and verdigris, and this to be repeated till the colour is very beautiful. With this view, 110 lbs. 5 oz. 10 drs. of silk, 44 lbs. 2 oz. 4 drs. of nutgalls, 66 lbs. 3 oz. 6 drs. of sulphate of iron, calcined to redness, the same quantity of logwood, and 11 lbs. 9 drs. of verdigris, were employed.

The silk is to be first wrung out of the galls; allowed to dry, and then strongly shaken by the hands, in order to ventilate and detach it from the galls.

The same process of rubbing, shaking, &c., is to be employed in respect to the logwood bath; and the silk is to be carefully washed after each immersion in the solution of sulphate of iron. In the last logwood bath, is to be dissolved 2 oz. 15 drs. of gum arabic, to 1 lb. 4 oz. 4 drs. of silk. The black is softened by passing the dyed silk through soap and water. By combining vegetable astringents with the nutgalls, a softer and more agreeable colour was produced. Oak bark, a species of agaric, pomegrate bark, &c., may be employed for this purpose.

Blue. By Mons. Raymond.

When the silk has been cleansed, immerse it ¼ of an hour at

the ordinary temperature in water containing $\frac{1}{20}$ of its weight of the sulphate of the peroxide of iron. Wash; hold it for $\frac{1}{4}$ an hour in a bath, nearly boiling, of soap and water. Wash again; put in a cold weak solution of prussiate of potash, soured by sulphuric, or muriatic acid. As soon as it is immersed it becomes blue. In $\frac{1}{4}$ of an hour wash and dye it. This dye becomes dull in the sun, but will regain its brilliancy by being kept in the dark.

Chaptal says, to obtain *Turkish blue*, the deepest of all. the silk should be immersed in a strong, warm bath of savary, before putting it into the vat.

To obtain the *Royal blue*, also a deep colour, and permanent, cochineal is employed in place of savary.

This last blue may be successfully imitated, by first immersing the silk in a solution of 1oz. 7½ drs. verdigris, to 1 lb. 4 oz. 4 drs. of silk. The silk is afterwards disposed in a bath of logwood, in which it assumes a blue colour, which is fixed by passing it through the vat.

Silk to be dyed blue, is usually boiled in a bath of 44 lbs. 2 oz. 4 drs. soap, to 110 lbs. 5 oz. 10 drs. silk. It is carefully washed, and twice put through running water; afterwards made into skeins; plunged into the vat by means of the wooden roller until it has acquired the desired shade. It is then wrung, shaken in the air, washed, again wrung, and hung up to dry.

When silk is to be dyed blue without boiling, the whitest kinds are chosen; they are dipped in water that they more readily imbibe the dye.

EXTRACTS FROM A GERMAN TREATISE ON DYEING SILK.

[*The following receipts are proportioned to* 10 *lbs. of silk boiled.*]

A HANDSOME YELLOW. Take 1¼ lbs. alum: 20 lbs. St. Mary's thistle [the carduus Marie] and ½ lb. woad ashes. Dissolve the alum in 10 buckets water; pour it into a vat; fix the silk upon rods. steep it; work it well an hour; wring it; lay it aside wet. Into 10 buckets water in a kettle add the *carduus Marie*, boil ¼ of an hour; strain; let it cool to suffer your hand in it; steep the silk in this; work well half an hour; wring; and lay it by wet. The pails with the alum water, as well as those with the decoction, must be filled and kept full during the working process to near the top. In filling up, or supplying the evaporation, do not cool it below what your hand can bear. Put the *carduus Marie* the 2d time into the kettle, with fresh water; boil again; take out the silk; dip out some of the liquor in which you had previously worked the silk; add *as much* of the 2d boiling to it; stir the liquor always before you steep the silk in it; steep the silk again, and work it well for half an hour; keeping up a higher temperature than at the first operation, but not too hot, or it will injure the silk. Now dissolve the woad ashes in a kettle, pour on it some of the 2d liquor, boiling hot;

stir well, and then let it settle; next pour the clear part of this solution into the yellow liquor, first taking out the silk; stir well; steep the silk again, and work it well 15 minutes. Then, or sooner, take out a small quantity of the silk; wring it, examine its shade, if the colour is not good, add a small quantity of the solution of woad ashes to this liquor; steep the silk again, and let it be well worked until the colour is obtained. To give the silk a deep golden tint, add to the solution of woad ashes some annotto.

CITRON YELLOW. Take 1¼ lbs. alum, 8 lbs. safflower; ¼ lb. alum.

Dissolve the alum in 10 buckets of water; pour the solution into a vat; steep the silk in it; work it well half an hour; wring, and lay it by wet. Throw away the alum solution as useless, and put 10 buckets of fresh water into a kettle; add 8 lbs. safflower and ¼ lb. alum; boil for half an hour, strain the decoction into the vat; steep the silk in it; work it well ¼ of an hour; wring; dry, and beat it well. The left liquor will dye a pale yellow.

ANOTHER CITRON YELLOW. Take 1¼ lbs. alum; 14 lbs. safflower, and ¼ lb. alum.

To 10 buckets water in a kettle, add 1¼ lbs. alum; dissolve; pour into the vat; work the silk in the solution ½ an hour; wring, and lay it by wet. Next pour 10 buckets fresh water into the kettle; add 7 lbs. safflower; boil ½ an hour; strain into the vat; work it well for 15 min.; wring, and dry it. The yellow liquor now pour back into the kettle; add 7 lbs. safflower, (remaining,) also ¼ lb. alum; boil the whole ½ an hour; strain into a pail; work the silk well in this ½ hour; wring; dry and beat it well.

CITRON YELLOW *in a different way*. Take 1¼ lbs. alum; 7 lbs French berries.

Dissolve the alum in 8 buckets water; pour this into a vessel; immerse the silk in it; work it well ½ an hour; lay it by wet; and throw away the solution. Then boil 10 buckets of water; put into it the French berries; boil for ¾ of an hour; add a small quantity of alum to the berries; strain into a bucket; immerse it in the liquor; work well ½ an hour; wring well. To make the colour deeper or lighter, add or diminish the Fr. berries.

CITRON YELLOW *another way*. Take 2 lbs. alum; 6 lbs. quercitron bark, ground.

Alum in 10 buckets dissolved; pour it into the vat; immerse the silk in it, work it well 2 hours; wring; lay it aside wet; throw away the alum water; put 10 buckets fresh water into a kettle; the ground quercitron bark into it; boil one hour; strain into a pail; immerse in this liquor; work for an hour; wring well; dry. Preserve the yellow liquor.

A PALE YELLOW. Take 2 lbs. alum.

Prepare as above. Then warm the liquor used in the foregoing operation; put it in a pail; immerse; work well half an hour;

wring well; wring on a post; beat it well; and it will be glossy. It need not be rinsed.

CITRON YELLOW. Take 3 lbs. alum, and 1 lb. 3 oz. quercitron bark. Put the alum in a kettle with 10 buckets of water; let it dissolve; pour it into a pail; immerse the silk; work it well and longer than usual; wring; rinse, and lay it by wet. Now put 10 buckets water in a kettle; warm it; put the quercitron in a bag; boil until the strength is extracted; immerse the silk in it; work it well ¼ of an hour, and it is a handsome lively citron.

A HIGH YELLOW COLOUR. (10 *lbs. silk.*) Add to the above yellow liquor a few ounces soda, according to the deep or bright shades desired; but not until the silk is completely saturated with the liquor of quercitron.

ORANGE. (10 *lbs. silk.*) Add to the above liquor at the same time with the soda, a proportional quantity of annotto, and work it well in.

A PALE YELLOW, or *straw colour.*—Take less alum and quercitron, and dispense altogether with the soda and annotto.

BUFF.—To produce the many different shades of this colour, proceed with the quercitron in the same manner as directed in the dyeing of the same colours with turmeric and weld, (dyer's weed.) But 1 lb. of quercitron will equal 10 lbs. of either the turmeric or weld.

A VERY LIVELY GLOSSY YELLOW.—To increase the above to its most lively and glossy hue, take instead of the alum, a solution of tin dissolved in a mixture of 3 parts spirits of salts, and 1 of nitric acid. Mix this with 20 times its own volume of water, and immerse the silk, first well alumed. Do not rinse. It may be coloured immediately. The solution of tin may be preserved.

A TURKISH BLUE.—Take 2½ oz. cochineal; 10 oz. aquafortis; 1½ oz. English tin, and ¼ lb. alum. The silk must first be coloured in a keep, to a medium blue. Then place in a kettle 10 buckets of water, into which put 2½ oz. cochineal, and boil it well for 10 minutes. During the above process, dissolve the tin in the aquafortis, *sec. art.* Next pour the solution with ¼ lb. of alum into the said kettle, stir well; immerse the silk, work it well for ¾ of an hour, keeping up a steady, slow, continued boil. Then take it out, wring and beat it well to restore it to its natural gloss. By doubling the alum and substituting ¼ lb. of cream of tartar, the aquafortis may be dispensed with.

A REAL PINK. Take 15 lbs. of safflower; 15 quarts strong vinegar; ⅜ oz. oil vitriol; 1 lb. 14 oz. potash, and 4 oz. cream tartar.

Put the 15 lbs. of safflower in a bag, tie it tight, immerse it 48 hours in running water, taking it out every 6 hours; tread it well with your feet, and continue till the yellow matter is worked out of it, then take it out, put it in a pail, and pour on it six buckets of river water. Next put 1 lb. 14 oz. potash in a crock to dissolve it in water, decant the clear liquor on the safflower in the

tub, mix well, set it in a cool place for 6 hours. After this take out the safflower with the liquor; strain in a pail, put in this half a bucket of water; press it out to extract the colouring matter; pour 15 quarts of vinegar and $\frac{3}{8}$ of an ounce of oil vitriol into the liquor. Next take 10 lbs. of silk on rods; put it into this mixture, work it well for 4 hours. Rinse in a stream; wring well, and lay it aside wet. *Lastly*, dissolve 4 oz. cream tartar in soft water; decant the clear part of this into a tub, with 8 buckets of river water. Immerse the silk, which was before a light red, in this solution—work it well $\frac{1}{4}$ of an hour. Wring and dry it. For a pink of a higher colour, or for a lighter, take *more* or less safflower, and add a small quantity of vinegar.

A HIGH COLOURED CRIMSON. Take $1\frac{1}{4}$ lbs. cochineal; 1 lb. galls; 4 oz. cream of Tartar; and $2\frac{1}{2}$ lbs. Roman alum. By reducing the quantity of cochineal to 10 oz. and substituting for the remainder 3 lbs. of persico, or cutbear, the colour will be nearly the same, but with a slight bluish cast.

To use the receipt above, dissolve the alum in 10 buckets of water. Decant the clear liquor into the vat, and immerse the silk in it, working it well for 4 hours. Rinse in a stream; wring, and lay it by wet. Then to 8 buckets of boiling water, add $1\frac{1}{4}$ lbs. finely powdered cochineal, 1 lb. do. nutgalls, and 4 oz. cream of tartar. Boil these slowly for 15 minutes, cool with 2 buckets of water, work it well in the liquor, the boil being continued for $1\frac{1}{2}$ hours. Rinse, wring, and dry it.

A HANDSOME CRIMSON.—Take 3 lbs. of Roman alum; $\frac{1}{2}$ oz. argol,* (cream tartar,) $\frac{1}{2}$ lb. East India galls well powdered; 25 oz. cochineal.

Put 8 buckets rain water, lukewarm, in a kettle, into this 3 lbs. Roman alum; dissolve; put the solution in a pail, immerse it; work well eight hours; wring lightly, and lay it by wet; heat 8 buckets spring water; just boil it; put in $\frac{1}{2}$ oz. argol and $\frac{1}{2}$ lb. powdered galls; boil all well 10 minutes; strain in a pail; pour the liq. back into the kettle; put in 25 oz. cochineal pulverized; boil 10 min.; cool with $\frac{1}{2}$ bucket water; immerse the silk in it; work well for 2 hours; keep boiling; rinse; wring strongly, and dry it. Take 10 buckets water in a kettle, heat it just to bear your hand; work well for $\frac{1}{2}$ hour; then wring it, dry it—done. An ounce argol may be used.

A DEEP RED. Take 1 lb. fine galls; $2\frac{1}{2}$ lbs. alum; $\frac{1}{2}$ lb. composition, and 5 lbs. madder.

Put into 8 buckets of water 1 lb. fine galls; boil 15 minutes; take it out; run it through a sieve into a vat: steep the silk in it; work it well for 2 hours; take it out, rinse, and dry it. Then put into a kettle 8 buckets water, $2\frac{1}{2}$ lbs. of alum, and $\frac{1}{2}$ lb. of the composition; unite them in the water. Pour the mixture

* Red argol is the tartar from red wine; white argol is the impure deposit from white wine. Cream of tartar is pure argol.

into a vat, steep the silk in it, work it well for 4 hours; then take it out, rinse, and lay it by wet. *Lastly*, put in a kettle 10 buckets water, and 5 lbs. madder. Work the silk well in this until it boils. Rinse and dry it.

A REAL BROWN. Take 6 oz. annotto, 1 lb. potash, 3 lbs. alum; 5 oz. nutgalls fine; ¼ oz. cream tartar; 2 oz. turmeric, and 10 oz. cochineal.

Boil the annotto in 10 buckets water, and put it with 1 lb. of potash into a kettle. Boil ½ of an hour; strain the liquor into a tub, immerse the silk, work it well for 2 hours, rinse, wring and dry it. Next to 8 buckets water add 3 lbs. alum; dissolve it; put the solution in a vat. Steep the dried yellow silk, work it well for 3 hours, wring and lay it by wet. Now prepare a kettle with 8 buckets water. Bring it to boil. Put in it 10 oz. coch.; boil for 10 minutes, cool it with a bucket water. Put into it ¼ lb. cream tartar, and 2 oz. turmeric. Stir well, steep the silk, previously alumed; work it well for 2 hours. Rinse in running water, wring, and lay it by wet. Now immerse it in a keep (dye tub) light or dark to your taste. The liquor of logwood will make it equally handsome, but not of a colour so lasting.

A REAL CRIMSON, *another way*. Take 2½ lbs. Roman alum; 2 lbs. fine pulv'd. galls; 1 lb. 4 oz. cochineal; ¼ lb. argol, and 8 oz. spirits of ammonia.

Put 8 buckets water in a kettle; into that 2 lbs. pulv'd. galls; boil ½ of an hour; strain into a pail; steep the silk in it; work it well 4 hours; rinse, wring and dry it. Next take a kettle with 8 buckets water, dissolve 2 lbs. Roman alum; pour it into the vat, steep the silk in it, work it 4 hours in same; wring it, and lay it by wet. Lastly, take six buckets water; pour it into the kettle; add the argol and the sp. ammonia; boil all together 10 min.; cool with 2 buckets water; work the silk well 2 hours, keeping it boiling: Then suspend it on rods over the vat; pour the liquor from the kettle into it; immerse the silk in this liquor until it is cool; rinse, and dry it in the shade.

To preserve the full benefit of the cochineal, pour the used alum liquor into it, and heat it again. This will give you many lighter shades, from the rich peach blossom, down to the lightest lilac colour. You may, lastly, take silk of a yellow ground and colour it in it, a reddish yellow.

A HANDSOME RED. Take 8 oz. annotto; 1½ lbs. potash; 2½ lbs. alum; 6 lbs. Brazil wood; 5 buckets sharp vinegar; and 6 oz. composition. [This *composition* is given on page 345.]

Take 8 buckets water in a kettle; let it boil: have ready powdered 8 oz. annotto; put the annotto and the potash into the above water, heated; boil for ¼ an hour; strain into a pail; steep the silk in it; work it well 2 hours; then rinse, wring, and dry it. Dissolve 1½ lbs. of alum in 8 buckets water; pour this into a pail; fix your silk upon rods; work it therein 2 hours; wring, and

dry it. When dry, steep the silk in warm water; soak it well; wring, and lay it by. Next pour the 5 buckets vinegar into a vat; also the 6 lbs. Brazil wood; let stand 48 hours; pour the liquor out of the vat into a kettle; boil 10 min., then strain it into a vat; the parts remaining into the kettle again; pour 3 buckets water upon it; boil for ¼ hour; and pour the liquor with the other Brazil wood into the vat. Again pour 6 oz. composition into this Brazil wood liquor; stir well; steep the silk, first well soaked in water for 2 hours. If the liquor still contains any colouring matter, take it out, pour it into the kettle again; work the silk another time in it, keeping it moderately warm: rinse in running water; wring, and hang it up to dry. Eight, instead of five buckets vinegar will greatly improve the colour. Omitting the composition altogether, the colour will become darker. If a darker and fiery hue is wanted, add 2 lbs. of Brazil wood, and 1 lb. of composition to the above.

A CITRON YELLOW, *with quercitron bark.* Take 2½ lbs. alum; ¼ lb. acetate of lead, 2 oz. chalk, and 3 lbs. quercitron bark.

Take a kettle with 8 buckets water; put in it 2½ lbs. alum; dissolve it; pour the solution into a pail; cool it; add ¼ lb. acetate lead; stir well; put in 2 oz. chalk; stir well again, and continue at intervals for 12 hours; let it settle; pour off this liquor into a pail, without stirring up the sediment; steep the silk in this; work it well for six hours; wring, and lay it by wet. Next take a kettle with 8 buckets water; put in it the quercitron; boil for ¾ of an hour; strain into the vat; steep the silk previously saturated in the above liquor into this; work it well an hour; rinse, wring, and dry it. For a higher colour, add 1 lb. more of quercitron; saturate the silk in the above liquor; then boil in a kettle 8 buckets water, with the 2 lbs. quercitron for ¾ of an hour; strain into a vat; steep the silk; work it well 2 hours; wring, and dry it. Lastly, take another kettle with 8 buckets water; put in 2 lbs. more of quercitron; boil for ¾ of an hour; filter into a vat; work in the previously coloured and dried silk for 2 hours; rinse, wring, and dry it.

A HIGH COLOURED, AND DEEP CITRON YELLOW. Take 1½ lbs. alum; 3 oz. acetate of lead; 1½ oz. chalk, and 8 lbs. French berries.

Dissolve, in a kettle of 8 buckets water, 1½ lbs. alum; pour the solution into a pail, or cask with a spiggot 6 inches from the bottom; let it cool; put in it 3 oz. acetate lead; stir well with a rake; add 1½ oz. pulv'd. chalk; stir the whole well every hour for 12 hours; then take out the rake; let the sediment subside for 12 hours; then draw off the liquor, not disturbing the sediment, which otherwise would create stains difficult to remove; pour this decanted liquor into a vat; work the silk well in it 4 hours; wring and dry it; after this, moisten it with warm water; rinse in a current; wring, and lay it by wet. *Lastly*, take a kettle with 8 buckets water; bruise 8 lbs. Fr. berries in a mortar; put them in the kettle; boil ½ hour; filter the liquor; steep the silk

in it; work for ½ hour; wring, and dry it. The liquor left will colour a brighter citron yellow; the same may also be used with turmeric or weld, in dyeing yellow.

NANKEEN. Take 2 lbs. powdered galls; 1½ oz. annotto; 4 oz. potash, and ½ lb. soap.

Put 1 lb. powdered galls in a kettle with 8 buckets water; boil 10 min.; strain the liquor into a pail; let ½ lb. soap dissolve in a bucket of warm water: pour it into the galls; put into a crock with water, 1 oz. annotto, and 4 oz. potash; boil for ½ an hour; add to the half of it the galls liquor in the pail; stir well; steep the silk in it; work it well ¼ of an hour; if the silk be a proper redness, add such proportion of the annotto liquor as is necessary to give it the desired tint; put the silk in again; work it well ¼ of an hour: rinse, and dry it. The nankeen colour must not remain long without being rinsed, as this would create stains in it.

A HANDSOME TURKISH BLUE. Take 1¼ lbs. alum; 2½ oz. cochineal; ½ lb. composition; ¾ oz. indigo, and 3 oz. sulp. acid. The silk, being boiled in soap and water, must be rinsed in running water, wrung, and well beaten; then coloured to a handsome light blue, in a cold or warm keep, rinsed in a stream, wrung, and dried. When dry, moisten it in warm water, wring it, and lay it by wet. Next, prepare a kettle with 8 buckets of water; dissolve in it ¼ lb. alum; pour it into a vat; steep the silk in it; work it well for one hour; wring, and lay it aside wet. *Lastly*, put in a kettle 8 buckets water; boil it; put into it 2½ oz. cochineal; boil for 10 min.; cool with a bucket water; add ½ lb. of the solution of tin, and ¾ oz. indigo, previously dissolved in 3 oz. sulp. acid; stir well; immerse the silk, coloured blue, in this coch. liquor; work well till the liquor begins to boil; let it boil another hour, working it all the time; rinse; wring, and dry it. If you desire a nearer approach to red, take more cochineal.

A HANDSOME GREEN. Take 2 lbs. alum and 4 lbs. quercitron. Dissolve in 8 buckets water in a kettle 2 lbs. alum; pour it into a tub; previously to this, colour the silk, in a cold keep, a handsome light blue; rinse in a stream; wring; steep the silk in the alum water; work well 2 hours; wring, and lay it by wet. *Lastly*, put 4 lbs. quercitron into a kettle with 8 buckets water; boil well ¾ hour; filter into a tub; prepare a mixture of indigo and sulph. acid, (nine parts acid to one of indigo, at 100° to 112° Fahr.;) pour this into the quercitron liquor in the tub; stir well; steep the silk; work it well ½ hour; wring, and dry it. If the colour requires, add a small quantity of turmeric to the yellow liquor. Let the silk not be coloured too dark in the cold keep; as a handsome green is difficult to procure on a ground spoiled by keeping it in the dark. If the colour is light, it is easier regulating it in the final dye to the required shade.

Best blue, (*ultra marine.*) Put copper filings, free from alloy, into a glass vessel, with muriatic acid in double quantity. Let them stand 24 hours or so, till the *mur. acid* attain a blue or deep green colour. Pour off the clear spirit of salt (mur. acid) into another glass vessel, add fresh mur. acid to the copper filings, repeat the process until the filings are dissolved, leaving the residuum remaining. To these solutions together, add the spirits of ammonia to saturate the mixture. Then moisten the silk in warm water, all its parts being equally soaked. Then wring it; steep it in the above solution or mixture; work it till it has attained the intended colour; take it out; wring it well; rinse it in a stream; and dry it in a shade. To the remaining liquor, add a small quantity of spirits of ammonia, and other handsome blues can be made.

For a dark blue, take 1½ oz. indigo; ¾ lb. oil of vitriol; 1¼ lbs. alum; 4 oz. logwood, and ¼ lb. of alum.

Finely levigate and sift the 1½ oz. indigo; put ¾ lb. of oil of vitriol in a stone jar, to which add the former. Stir well with a long, new pipe-stem, or such like thing, till the ferment ceases. Set it by for 24 hours; then add a little water, and stir again; after which, set it by till wanted.

Next take a kettle with 8 buckets of water; put in it the 1¼ lbs. alum, and dissolve it completely. Then pour the solution set aside into a pail, steep the silk therein, working it well for an hour; then take it out, wring, lay it by in a wet state for use.

Put 8 buckets of water into a kettle; pour the indigo solution into it; mix by stirring; put in the silk, stir it therein for an hour. Then rinse in running water, wring, and set it by wet. It is now a light blue colour.

To deepen it, or render it dark blue, take a kettle with 16 buckets water, brought to a boil; put therein 4 lbs. logwood, boil for ¾ of an hour. Take half this liquor, and strain it into a tub; put into this tub ¼ lb. alum, previously dissolved; stir well, and steep the light blue silk in it, working it well ¼ of an hour. Take it out, wring, and keep it in a wet state. Throw away the liquor in the tub.

Lastly, pour into another vat the remaining 8 buckets left in the kettle; run it through a sieve; steep the silk in the liquor, and work it well for ½ an hour. Then take it out, rinse it in a stream, wring, and dry it.

A violet blue, *after the manner of the foregoing.* Take 1 oz. indigo; ¾ lb. oil vitriol; ¼ lb. alum; 4 lbs. logwood, and 1 lb. Guinea or red wood.

The indigo must be dissolved in the oil of vitriol, as in the foregoing receipt, and kept ready for use; then dissolve in a kettle of 8 buckets of water, 1¼ lbs. alum, pour the solution into a tub, work the silk well one hour, take it out, wring it, and keep it wet. Next, fill a vat with 8 buckets of water; pour into this the above solution of indigo, stir well, work the alum-dressed

silk therein ½ an hour, take it out, rinse in running water, wring, and set it by in a wet state. Lastly, put 8 buckets of water into a kettle with 4 lbs. logwood and 1 lb. of Guinea or red wood. Boil the whole well for ¾ of an hour, run this decoction through a sieve into a vat, steep the blue coloured silk in it; work well for ½ an hour, then rinse in running water, and dry.

A DEEP RED. Take 5 oz. annotto; 1 lb. potash; 2½ lbs. alum; and 5 lbs. madder.

Into a kettle with 8 buckets water, put 5 lbs. madder finely powdered; add 1 lb. potash; boil ¼ hour; filter this into a tub; steep the silk in it; work well an hour; rinse, and dry it; dissolve 2½ lbs. alum in a kettle, which pour into a vat; steep the silk in it; work it well 2 hours; wring, and dry it. *Lastly*, put 8 buckets water into a kettle; add 5 lbs madder; heat it, but do not let it boil; steep the silk (first in warm water, to saturate, and wring it out) in the above lukewarm madder liquor; work it well till it *begins* to boil; let it boil ¼ hour longer, working it continually; wring, and dry it.

A GREEN. Take 1¼ lbs. alum; 1 lb. potash, and 8 lbs. turmeric.

The silk must be first dyed in a cold keep to a handsome light blue; the colour laid cautiously *throughout;* rinse in a stream; wring, and lay it by wet. Immerse the silk next in warm water; let it be *equally saturated;* wring, and lay it aside wet. Next, prepare a kettle with 8 buckets water; put in 1 lb. potash and 1¼ lbs. turmeric: boil them well for 10 minutes; filter into a vat; steep the silk in this liquor; work it well ½ an hour; wring, and put it by wet. *Lastly*, put 8 buckets water into a kettle; add to them 1¼ lbs. alum; dissolve it; pour the solution into a tub; work well ¼ hour; rinse, wring, and dry in the shade.

CONCLUSION.

Statistics relative to silk, are far from being brought to that state to which, by experimentalists, they questionless should be, for the explicit and definite guidance of the young culturist. Few, if any, have aimed at *a mean*, or a *well defined average*, as the *unit of calculation*, throughout the entire volume of manipulation, from the mulberry seed, or egg of the silk worm to the cocoon; or, rather, to the pound of silk, the yard of fabric, or even to the amount passed to the credit of each that shares in *the division of labour* in this important order of *national industry*. In all things relative to one genus or species, notwithstanding varieties, or deviations occasioned by contingency, *an average*, as before observed, *does and must exist*, however confused views and vacillating practices, a sort of navigation that never dreamt of polarity, may determine to the contrary. Instead of establishing this unit, or common measure, examples are given from all the varieties of the mulberry, species of the silk worm, and methods of treatment; and to increase this vibration from right to left of a right line, whatever that line be, ratios are given, without reduction, from the pounds and ounces of different European countries, which vary one from the other, as much as the pound avoirdupois does from the pound troy. The consequence of all this is, that discrepancy is frequently made to appear, where real agreement exists; or the latter has been supposed, whilst the former has been concealed.

No writer has exemplified a course of treatment, which can, with greater safety be referred to, as the unit in this respect, or standard to which all may attain, than the Count of Varese. Though in the appendix, a Milan pound of 12 ounces is adverted to, yet in the body of the work, it is evident that the count is conducting his calculations, by the poids de marc of Charlemagne; a pound of 16 ounces, each of 576 grains; one of which being equal to ·8203 of an English grain, the whole pound was equal to 7561 English grains.* Now, it is of this pound he is speaking, when he informs us that 240 of his cocoons, from the common worms of 4 moultings, weighed 1 lb. And as the English avoirdupois pound is equal to 7,000 grains troy, it must follow, that such was the excellency of his feeding and management, and therefore his cocoons so heavy, that it required only 222 of

* We have only to refer to page 338 to be satisfied that he calculates by an ounce of 576 grains, and to page 336 to be assured that the pound to which he constantly refers, is one of 16 ounces: i. e. 9,216 grains equal to 7,561 English troy grains.

them to weigh a pound avoirdupois; a result similar to this, is precisely such, as under similar circumstances, we should have expected.

Number of cocoons to the pound avoirdupois. We are fully aware of the widely discrepant quotations on this subject by different writers, *not having a standard of any kind whatever in view;* which, therefore, range at all ratios from 160 to 600, and even upwards, to the pound. In proportion precisely as we neglect or starve the insect we shall diminish the cocoon; and it remains to be shown, that Americans, if only they have the enthusiasm of the Italian prototype, cannot come so near to the standard as to raise cocoons of such excellency that 250 shall be equal to 1 lb. avoirdupois. When this can be demonstrated in the affirmative, on the possibility of which, with the condition specified, we have no doubt; we shall not hesitate to say, that 250 cocoons to the pound, are the standard, the unit of calculation, of the medium circumstances we contemplate. Rejecting examples of extraordinary deviations, either from the species of insect employed or negligence of treatment, the mean of the 14 examples quoted in the subjoined note,* not of this character, is 245 cocoons to the pound avoirdupois; affording sufficient presumption, that under circumstances already specified, especially with the aid of the multicaulis tree, the careful culturist will realize cocoons of 250 to the pound. And with this evidence before us, we are inclinable to add, that in every case, where more cocoons of the common worms are requisite to weigh one pound; the only allowable inference is, that the feeding and treatment have not been equal to what were exemplified at Varese.

Pounds of cocoons to the pound of silk. On this subject we have taken the trouble not only to collect 30 examples from the most respectable authorities, but also to reduce them, as in the subjoined note,† to a common ratio. The result, or the average of these 30 examples is, that it requires 9 lbs. $4\frac{1}{3}$ oz. of cocoons to yield 1 lb. of reeled silk. It will be seen by reference to the note, that the minimum quantity yielding 1 lb. of reeled silk is 5 lbs., the maximum 13 lbs. 10 oz: 10 examples of the 30 were each 8 lbs., and only 3 examples below 8 lbs.; 4 examples between 8 and 9 lbs.; one of 9 lbs.; one $9\frac{1}{2}$ lbs.; 3 of 10 lbs., and 7

* 222, Dandolo; 200, in Georgia; 160, A. Benjamin; 300, Roberts; 300, Cheney; 306, Busti; 337, d'Homergue; 250, Kenrick; 256, Pullein; 240, Judge Bry; 206, Mrs. Davenport; 206, Silk Culturist; 239, Bonafoux; 206, Stevenson.

† Two examples of only 5 lbs. each; one of 7 lbs. 8 oz.; 10 of 8 lbs. each; $8\frac{1}{8}$ lbs.; $8\frac{5}{16}$ lbs.; $8\frac{1}{4}$ lbs.; $8\frac{3}{4}$ lbs.; 9 lbs.; $9\frac{1}{2}$ lbs.; 3 of 10 lbs. each; 11 lbs.; 4 of 12 lbs.; $12\frac{1}{2}$ lbs.; $13\frac{5}{16}$ lbs.; $13\frac{3}{8}$ lbs. Authorities; Dandolo, De Hazzi, Bonafoux, Congressional Report, Dr. Lardner, Cobb, Kenrick, Roberts, Silk Culturist, Fessenden, Stevenson, Busti, Davenport, Murray. Transac. Am. Phil. Soc.

exceeding 10 lbs. The arithmetical average 9 lbs. 4½ oz. We, therefore, are fully warranted in stating 10 *lbs. of cocoons to* 1 *lb. of reeled silk*, as the whole number unit of calculation at this stage of our statistical investigation. And as 250 cocoons have been, under the conditions specified, taken as the number weighing 1 lb.; it must follow, on the same condition, that 2,500 *such cocoons will yield* 1 *lb. of reeled silk*; which is equivalent to a requirement of 2,500 *worms that shall survive from the egg to the cocoon to produce* 1 *lb. of reeled silk*. Again, as of the 36,244 eggs that weigh one ounce avoirdupois, (see page 293,) 26,650, with Dandolo's care, are supposed to survive. From every ounce of silk worm eggs, therefore, at the same rate of treatment, we may expect 106 lbs. 9 oz. of cocoons, or 10 lbs. 10½ oz. of reeled silk. Hence, we may derive the following table of the proportionality that practically may exist between from 1 ounce to 40 ounces of eggs, or to more than a million of surviving worms, and their product in the weight of cocoons and of reeled silk.

Ounces of Eggs.	Worms surviving to the Cocoon.	Weight of Cocoons.		Weight of Reeled Silk.	
		lbs.	oz.	lbs.	oz.
1	26650	106	9	10	10½
2	53300	213	2	21	5
3	79950	319	11	31	15½
4	106600	426	4	42	10
5	133250	532	13	53	4½
10	266500	1065	10	106	9
20	533000	2031	4	213	2
30	799500	3196	14	319	11
40	1066000	4262	8	426	4

From these data, it must necessarily follow, that an *average* cocoon will weigh $\frac{7000}{250}$, or 28 grains, and will contain $\frac{7000}{2500}$, $2\frac{4}{5}$ grains of silk. Relative to the length of fibre contained in a cocoon, quotations vary commonly from 300 to to 800 yards; but Count Dandolo will give us example of those whose fibre exceeds half a mile, and in one case (p. 331) of cocoons, whose fibre is each equal to 1295 yards, or nearly three quarters of a mile! Of each cocoon, the proportion of silk that *can be reeled* to the floss

that *can only be spun*, is, by the most reputable authorities, quoted as 19 to 1. One pound of reeled silk is ordinarily manufactured into 16 to 19 yards of the silk called gros de Naples, which, at average prices, is worth from $10 to $14: i. e. $5 for the raw material, and from $5 to $9 for the manufacture per pound. Different authors give from 300 to 600 as the number of eggs laid by each female moth. Dandolo qnotes 510; consequently, about 78 female moths, or 156 moths of both sexes, are requisite to the production of one ounce of eggs.

Feeding statistics. We have yet three important inquiries before us. In order to obtain any quantity of reeled silk, from 10 lbs. to 400 lbs. and upwards, or the silk yielded by the worms surviving from 1 ounce of eggs to 40. 1st, what will be the weight of leaves requisite in each of those cases? 2dly, the extent of land necessary for their growth? and, 3dly, the average nett profit on each acre employed in the production of silk?

1st. On accounting for the different number of worms for which the Counts de Hazzi, Dandolo, and M. Bonafoux, calculate, and the difference between the weights of Bavaria and Milan, we shall find a striking agreement between them relative to the quantity of leaves requisite, during each of the ages of the silk worm, respectively. The calculation of Dandolo was for 144,000, or the worms surviving to the cocoon of 5 oz. of eggs, as is stated below.

	For five ounces of eggs.			For one ounce.
Ages.	Of sorted leaves.	Refuse.	In all.	In all.
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
1	30 0	4 8	34 8	6 14 4/5
2	90 0	15 0	105 0	21 0
3	300 0	45 0	345 0	69 0
4	900 0	135 0	1035 0	207 0
5	5490 0	510 0	6000 0	1200 0
Total.	6810 0	709 8	7519 8	1503 14 2/5

For the maintenance, then, of 144,000 *surviving* worms, or the worms surviving from 5 ounces, equivalent to 576 English pounds of cocoons, or 57 lbs. 9 3/5 oz. of reeled silk, 7519 lbs. 8 oz. of the white mulberry leaf must be taken from the trees; and as the pound used in Dandolo's statistics was equal to 7561 English grains, and our avoirdupois pound to 7000 grains,

it is evident that his 7519 lbs. 8 oz. of leaves are equal to 8123 lbs. nearly of leaves, according to our pound avoirdupois; for which he obtained 600 lbs. of cocoons; and since he informs us, that "in the year 1814, which was unfavourable, my cocoons yielded me about 15 ounces of very fine silk from 7½ lbs. of cocoons." We have evidence that he obtained 75 lbs., equal to 81 lbs. of our weight, from 600 Milanese pounds of cocoons; which is at the rate of 100 lbs. of white mulberry leaves nearly, ($\frac{8123}{81}$,) for every pound of reeled silk; to which, according to the evidence before us, 80 lbs. of multicaulis leaves are equal, on account of the greater quantity of nutritive matter, and less of refuse, in each pound of the latter. Hence, at this rate, 6498 lbs. avoirdupois of multicaulis leaves are sufficient to rear the worms proceeding from 5 ounces of eggs, or to the production of 81 lbs. of silk, at the rate of culture accomplished by the vigilance and care of Dandolo during an unfavourable year. This is at the rate of 1300 lbs. nearly of multicaulis leaves for every ounce of eggs; or of 45 lbs. of multicaulis leaves for every 1000 worms.

Hence, the weight of multicaulis leaves requisite for the worms that may, and should, with successful treatment, proceed from one ounce, is equal to 1300 lbs.; from 2 ounces, 2600 lbs.; from 3 ounces, 3900 lbs.; from 4 ounces, 5200 lbs.; from 5 ounces, 6500 lbs.; from 10 ounces, 13000 lbs.; from 20 ounces, 26000 lbs.; from 30 ounces, 39000 lbs.; and from 40 ounces, 52000 lbs.

At page 221 and 222, we have not calculated on more than 6¾ lbs. of leaves from 1 multicaulis plant of the third year's growth. Mr. Roberts, in the last edition of his manual, allows 15 lbs. for the foliage of the multicaulis of the 3d year, and 16 lbs. for its 4th year; and as by planting 8 feet asunder in the rows, and 1½ feet from tree to tree in each row, 3630 trees may be planted in one acre, which, at the ratio specified by Mr. Roberts, would yield 58080 lbs. of leaves, more than sufficient for the feeding of 1,000,000 surviving worms, which, at 2500 cocoons to the lb. of reeled silk, are equal to 400 lbs., that, at $4 per lb. would yield $1600 per acre.

The particulars of the expense of cultivating this acre, and for feeding the 1,000,000 worms, &c., he estimates as follows: "Interest on 1 acre of land, valued at $20, at 6 per cent. is $1 20; manure for ditto $20 00; ploughing and harrowing, $5 00; wages of one woman for 6 weeks, at $3 per month, $4 50; board for ditto, at $2 per week, $12; wages of one woman for 5 weeks, at $3 per month, $3 75; board for ditto, at $2 per week, $10; wages of 5 children, from 7 to 10 years of age, for 4 weeks, at $1 per week each, $20; board of ditto, 4 weeks, at $1 50 per week each, $30; expense of reeling silk, $50; interest in cost of the cocoonery, $48; or expenses in all, $204 85. Which, deducted from the $1600 stated above, would leave the

nett profit of $1395 14 per acre. We hope that Mr. Roberts' results will be realized. He has taken 16 lbs. for the yield in foliage of the multicaulis on the 4th year. We have taken not more than about half of this; and if the half of this profit per acre, or $697, or even $500 per acre be obtained, it will certainly be considerably more than can be realized from one acre, by any other species of crop whatever. now in cultivation, or which can be generally available

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THE author, Mr. S. AUGUSTUS MITCHELL, is favourably known to the public, having for a number of years past devoted his attention to the compiling and publishing of Geographical Works and Maps. The knowledge he has acquired in the prosecution of this business, has induced many of his friends, teachers in different parts of the country, to direct his attention to the present work, persuaded that he could prepare one suited to their views, and calculated to facilitate the progress of their pupils.

Geography forms at present an essential branch of elementary education, and is well calculated to awaken and cherish that spirit of curiosity and inquiry which is so natural to the youthful mind. On its value it would be needless to expatiate, and its proper regulation being calculated to open the way to more important studies, is not unworthy the illustration of mature and cultivated minds

Within the last twelve or fifteen years the great attention paid to Geography in our principal schools and seminaries, has been the means of producing several meritorious works on this subject. They have their respective peculiarities and excellencies, and are mostly well calculated to aid the scholar in his progress towards acquiring a competent knowledge of that interesting science. They ought not, however, to be regarded as superseding all further endeavours in this department of usefulness, or as discouraging any well-intended efforts of others to do good in a similar way.

To most of the works in question the objection attaches of failing to represent the world as it is at the present day. Perhaps not one of them (though editions for 1838 are before the public,) exhibit even our own country according to its actual divisions. The same objection exists in relation to South America and some other quarters of the world, where important States are neither mentioned in the Geographies nor delineated in the Maps.

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